MAY 6 1929

ENGINEERING AND MINING JOURNAL

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

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Starting Andes Copper's Electrolytic and Refining Plant

By Carr B. Neel

◆

Burma—an Important Source of Precious and Semi-Precious Gems

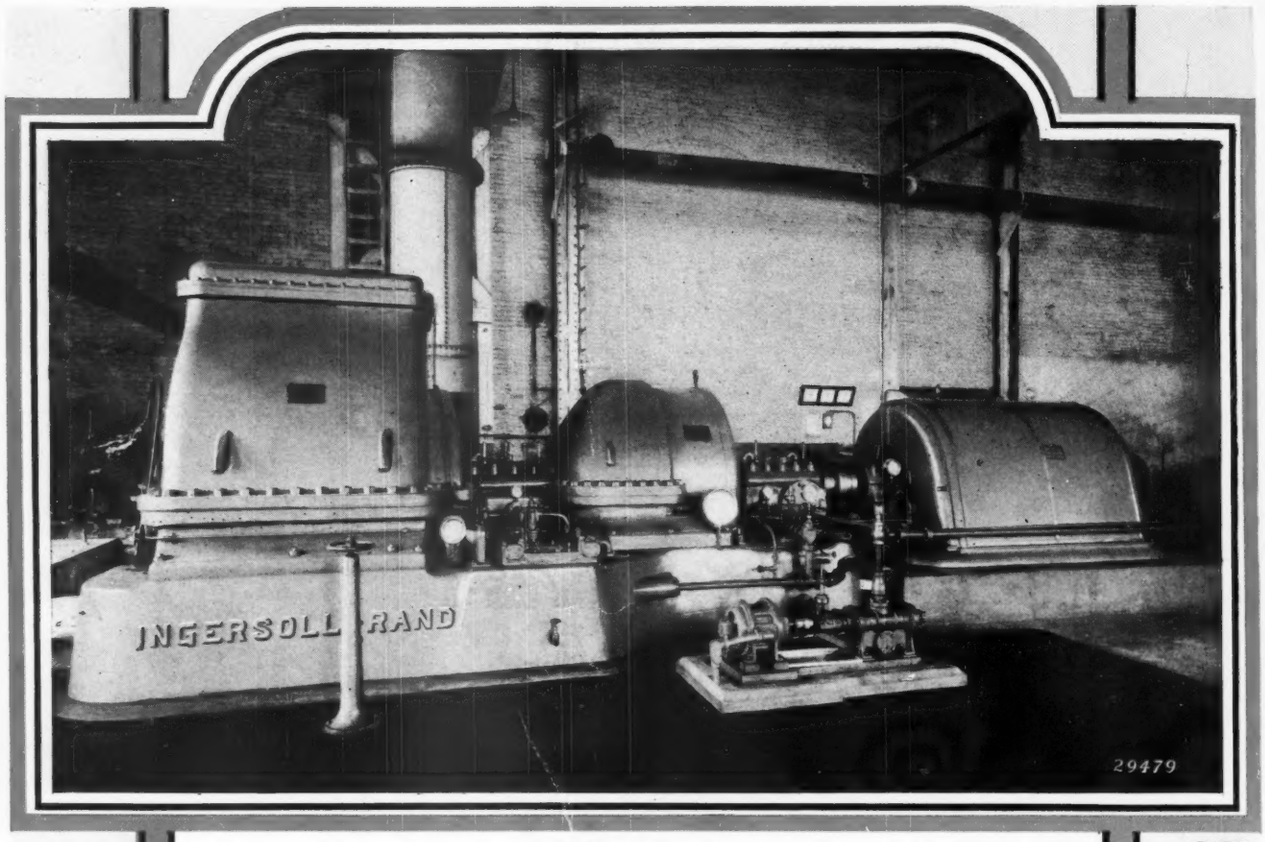
By Allan B. Calhoun

◆

The High Cost of "Cheap" Labor

◆

Complete Quotations on Metals and Minerals in This Issue



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Volume 127

ENGINEERING AND MINING JOURNAL

Number 18

A consolidation of "Engineering and Mining Journal" and "Mining and Scientific Press"

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New York, May 4, 1929

Features of *E.&M.J.*: VI—"By the Way"

THE mining industry affords a rich field for material suitable for publication in the department captioned "By the Way." This is not a joke column, though a humorous treatment of the subject is often suitable. Any interesting sidelight on our great industry—not too technical—is welcomed. Even poetry is sometimes used here, though the standard of mining poetry is unconscionably low, and most such contributions must be returned. Stories of the early days and anecdotes concerning men famous in the industry make excellent material for this section of the magazine. The wives of mining engineers here have an obvious opportunity to entertain without cost.

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McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Ave. at 36th St., New York, N. Y.

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NEW YORK District Office, 285 Madison Ave.
WASHINGTON, National Press Building
CHICAGO, 520 North Michigan Boulevard
PHILADELPHIA, 1600 Arch Street
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie St., London, E. C. 4

Cable Address: "Machinist, N. Y."

Publishers of
Engineering News-Record — American Machinist
Power — Chemical and Metallurgical Engineering
Coal Age — Engineering and Mining Journal
Ingeniería Internacional — Food Industries
Electrical World — Electrical Merchandising
Bus Transportation — Electric Railway Journal
Construction Methods — Radio Retailing
Aviation
Electrical West
(Published in San Francisco)
American Machinist—European Edition
(Published in London)

SUBSCRIPTION PRICES: United States, $6 a year. U. S. possessions, Canada, Mexico, and the countries of Central and South America, $7.50 a year. All other foreign countries, $10 a year. Single copy, 25 cents. Published weekly. Entered as second-class matter, June 30, 1879, at the Post Office, New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

CHANGE OF ADDRESS
Subscribers are requested to send both the old and the new address when they move to a new address.

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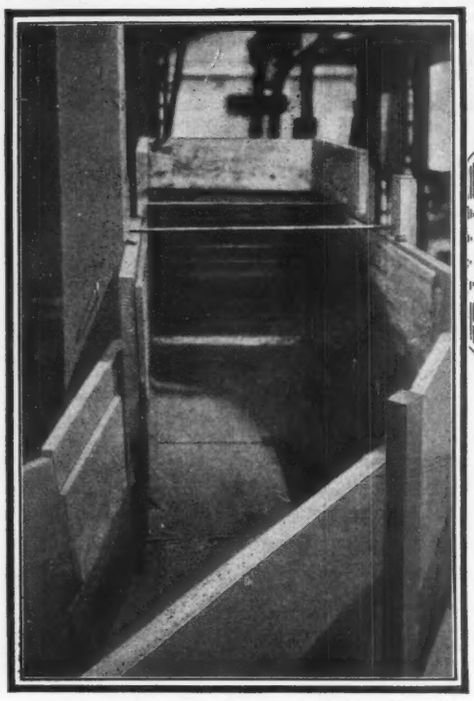
McGraw-Hill Publishing Company, Inc.

Member—Audit Bureau of Circulations.
Member—Associated Business Papers.

11,381 Copies Printed This Issue

Total Number of Issues to Date 3,280



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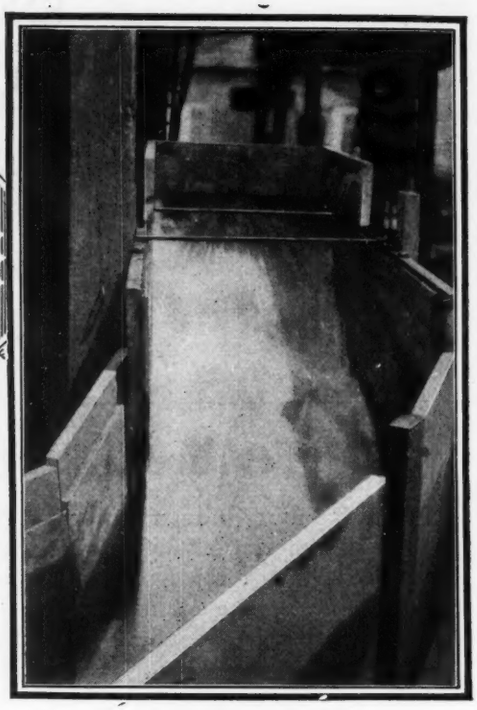

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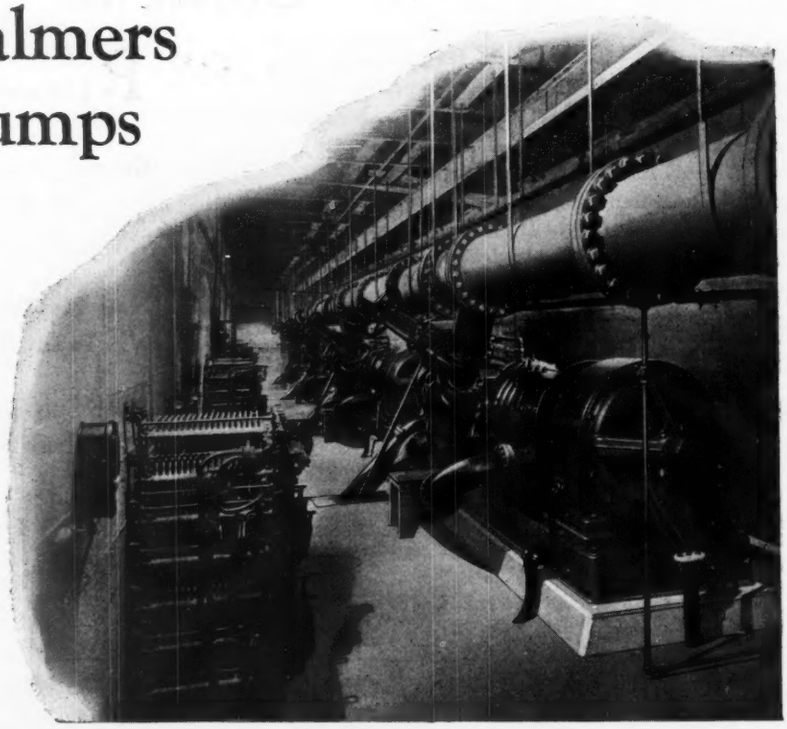

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ENGINEERING AND
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Volume 127 — *New York, May 4, 1929* — Number 18

Patent Office Records Provide a Mine of Information

SELDOM does the independent inventor realize that others may have studied the identic problem on which he has been laboring, performed exacting research and thorough investigation, and obtained one or more patents. It is this attitude of self-sufficiency that usually leads to his own undoing; for disappointment follows the almost inevitable discovery that "there is no new thing under the sun." The remedy, of course, when mental achievement or physical discovery prompts enthusiasm, is to hope for the best but prepare for the worst. The first step is to convey to paper the thought or the development, record the date of its inception or realization, have the document witnessed, and file it away in safe keeping for future reference.

Then should come the testing period. The invention must be described in specific terms, and the details elaborated with the aid of careful thought and experimentation. A statement of objects and purposes will prove helpful and stimulating. Additional opportunities for application will probably be evolved, and modifications in design or application will suggest themselves as the work proceeds. Finally, when every avenue of direct and indirect investigation and research has been exhausted, details of the complete invention—what it is, what it purposes to effect, and what benefit it will be to humanity—must be carefully presented. Then comes the essence of the preliminary work—the enumeration of what the inventor can conscientiously maintain is original and novel—the claims of a patent application, arranged in orderly sequence and of cumulative import, each of no more than one sentence, concise yet comprehensive. All this costs nothing more than personal labor. It is invariably worth while.

If inventors would realize the tremendous importance of clear statement as an essential complement to achievement, their tasks would be easier, and much fresh inspiration would be obtained. Despite frequent opinion to the contrary, we are opposed to the contention that the would-be patentee should take action before he has clearly enunciated his discovery in his own language. And if he is unable to do so, one may assume that he belongs to a class in which we, as engineers, are not deeply interested.

The advice to the inventor to make a sketch and add a few words of explanation, and then to take both to an attorney, is usually prompted by a desire to share in the immense aggregate sums invested yearly in preliminary legal fees by inventors who have devised nothing new, novel, or valuable. The advertisements in popular magazines of the many legal firms that urge those with "ideas" to take immediate action through an attorney offer evidence of an effort to create, and then capitalize on, a fear of loss of what is expected may prove of commercial value. But the ideas behind ninety-nine inventions out of every hundred could not be given away, much less sold for a "song," at any stage of their inception, development, or legal presentation. A normal baby is usually a phenomenon to its parents. The average inventor feels the same thrill, but only the legal fraternity finds financial profit in encouraging the enthusiasm and, incidentally, causing an appalling congestion in the Patent Office.

If practicable, an investigation into the state of the art—to determine what others already have done—should precede, not follow, research. In this respect the larger corporations display wisdom and evidence an appreciation of economy. As an example: The New York Central Railroad recently put into operation a new automatic signal system, supplementing the ordinary system, but providing for all emergencies and acts of human carelessness. Its engineering staff did not first plan an invention of the desired device. Instead, a search of the Patent Office records was made. The result indicated the existence of 3,600 patents covering mechanisms of the character sought. Of these, however, only nine were found to possess sufficient merit and promise to be important. The final invention—an adaption of details already recorded—was made by uniting and co-ordinating the valuable features in the inventions that already existed.

If this experience may be taken as typical, the percentage of worth-while ideas in patented inventions is therefore extremely small, and the investigator in any field would do well to bear in mind the truism that human ingenuity has followed its bent in an intensive search for the new and novel for many years. The fruits of most of its labors are available for inspection and classification. Selected patents invariably form the best foundation for research in any field of long-established engineering activity.

Co-ordinating the Work of Mineralogist and Metallurgist

A METALLURGIST rarely mentions the mineralogical composition of an ore in an article on beneficiation. This fact is brought to our attention by a correspondent whose letter was not written for publication, but this particular comment deserves a wider publicity. Some articles are informative in this regard; but most are not.

Various explanations are available. The metallurgist is mainly concerned with his immediate observation or

achievement. He may assume that the reader possesses the information expected by our correspondent, or he may decide that a mineralogical description would be irrelevant. Or the editor may be at fault in making too sharp a line of demarcation between the various fields covered by a publication such as *Engineering and Mining Journal.*

Whatever the explanation forthcoming, however, the advice must be accepted that many a metallurgical article would be improved by a more precise description of the ore being treated. This description need not be detailed, but the engineer of broad interests certainly wishes to know the essential nature of the ore—the mineralogical and chemical characteristics that indicate amenability to standard methods of treatment, or the peculiarities that involve the development of a special metallurgical scheme. The inquisitive reader may ask what modification of standard metallurgical methods was made to overcome extraction difficulties, and what theory was applied in the application of such a modification.

The inquiry would prompt confession that practice does not invariably follow a study of theory. A little theory and much experience is considered an efficient working tool for the average metallurgist. In this connection we recall the procedure adopted, which ultimately proved successful, to discover a reagent for flotation, whereby experiments were made with all likely compounds in an alphabetical list. We recall, moreover, overhearing an irascible manager in Mexico order a subordinate to make a certain minor change in mill arrangement. Came intimation that plans would be prepared immediately. "Nothing doing," was the retort. "Put it in right away. Make the —— —— drawings afterwards, if you want to."

The Technical Journal Again Proves Its Worth

IN THE January *Journal of the Chemical, Metallurgical and Mining Society of South Africa,* Messrs. T. K. Prentice and R. Murdock give credit to Mr. V. J. Zachert and to his paper published in the *Mining & Scientific Press* of Oct. 12, 1918, for suggestions which led to a practicable method for the further treatment of the concentrate obtained by dressing platinum ores at Onverwacht, Transvaal. By crushing, grinding, and tabling, a recovery of over 80 per cent of the platinum metals was obtained, but the concentrate weighed 1.7 per cent of the original ore and assayed only about thirty ounces in platinum metals. Obviously, some further concentration was necessary, and Mr. Zachert's article showed how platinum could be amalgamated in the presence of copper sulphate, zinc, mercury, and suphuric acid. The South African metallurgists worked out from this suggestion a "treatment-house" practice, which resulted in the preparation of an enriched platinum product suitable for shipment to the platinum refiners. During the three years which ended with 1928, the Onverwacht reduction plant produced 21,820 ounces of fine platinum.

F. Wartenweiler said at the January meeting at Johannesburg: "Like many other processes, the amalgamation process used at Onverwacht had its beginning in the laboratory. The idea was gleaned from an old technical journal clipping in my files, but many experiments necessarily preceded the successful one. According to the account published, platinum recovered in California gold dredges had been amalgamated. A vast amount of detail work was required before the method was considered to be safe for transplanting and works adoption. It came just in time to supply the final and very important link in the chain of ore dressing and treatment."

We are glad to record the acknowledgments of our South African colleagues and the credit given to Mr. Zachert. The technical journal once more proves its value in disseminating ideas helpful to the industry.

Success Needs Faith as Well as Good Works

THE DISPUTE between the directorate of General Electric, Ltd., a British corporation, and its shareholders in the United States—caused by a proposal to issue additional stock that would be available to British subjects only—has been settled. The American interests have scored a victory. Enlightened public opinion was with them—in England as well as in the United States. As a result, the proposed issue, which had for its purpose the transfer of majority control from American to British hands, has been abandoned. The foreign stockholders are entitled to their property rights. Fair play demands that they be not deprived of the proportion of influence they secured by purchase in the open market.

The major argument advanced by the directors of the British company is a fundamentally sound one: that it is advisable to have stock control in consumers' hands. But the time has long since passed wherein precautions might have been taken to insure this. Surprising as it has appeared to the average Briton, 60 per cent of the old shares in this great concern are owned in the United States, and the holders are naturally unwilling to forfeit their rights and privileges, although standing aloof from the slightest interference in the management and operation of the company.

Success needs faith as well as good works. The United States, the birthplace of so many electric developments and of innumerable schemes and proved practices for the wider use of electric power, evidenced an early faith in the future of the electrical industry of Great Britain, backing this faith with capital. No question can be raised as to the relative prosperity or the relative availability of capital in the two countries in this connection. Great Britain has been shown to possess vast financial resources available for investment in commercial enterprises of this character, but in too many instances the money has been devoted to speculation. Only in recent years, with the application of schemes for government electrical co-ordination, initiated by the Central Electricity Board, and the adoption of what is known as the "grid" system, has the country awakened to the tremendous advantages that will follow the modernization program of electric power supply now being put into effect.

The majority control of American shareholders in General Electric, Ltd., has been achieved by a majority of faith on their part in the future of the British

electrical industry. One may well expect that success in cheapening and making more available a uniform electric power supply throughout the manufacturing district of Great Britain will act as a nucleus for the radiation of a spirit of optimism to the many other industries dependent on electric power at a low cost for cheaper and more efficient production.

The Hull-Rust-Mahoning Pit Still Earth's Largest

FROM THE POINT OF VIEW of the mining engineer nothing is impressive about an open pit, unless it be its dimensions and the capacity of the shovels used to work it. In operations of this class, the mining engineer finds little opportunity to apply his store of specialized knowledge. On its grandest scale the work savors more of digging a Panama Canal than of opening up a mine. Calling principally for a knowledge of surface excavation and the laying and shifting of railroad track, as well as of the operation of standard-gage ore and stripping trains, it falls as much within the field of civil engineering as within that of mining. Moreover, it is mining at its simplest. Only when conducted on a heroic scale does it attract attention.

Open pits of spectacular size have long been among the show places of the mining industry in the United States. Those for which the Mesabi range early became famous had their later rivals in the Ruth pit of Nevada Consolidated and in the smaller but interesting Sacramento pit, in Arizona, where a mountain has become a hole. The premier pit, in point of size, is that formed by the Hull-Rust and Mahoning mines on the Mesabi, together with the adjacent workings of the Burt, Day, Seller's, and Susquehanna properties. These combine to form one huge pit covering 1,080 acres, the Hull-Rust including ten forty-acre tracts, the Mahoning seven, and the remaining four mines ten, collectively.

In output of iron ore, the Hull-Rust-Mahoning workings have hitherto jointly topped the list, in 1927 producing the large total of 5,366,943 long tons. In 1928, however, the Hull-Rust tonnage fell off one-third, and, despite a 27 per cent increase in Mahoning's output, the combined production of the two—namely, 4,724,943 tons—was surpassed by that of the Missabe Mountain mine, which was 5,255,947 tons. The latter is a state-owned (Minnesota) property, operated under lease by the United States Steel Corporation's local iron-mining subsidiary. Its output in 1926 was greater than in 1928 by over 420,000 tons, but was surpassed in the former year by the more than 7,000,000 tons turned out jointly by the Hull-Rust and Mahoning.

Though leading in production, the Missabe Mountain property covers only four "forties"—a total of 160 acres. The heavy shipments made from it are due to the fact that the operators hold the property under a low fee from the state and must ship at a high rate to exhaust it before the date of expiration of the present lease in 1933. This rate will approximate 6,000,000 tons for the remainder of the period. For the next few years the Missabe Mountain will therefore probably head the list of shippers. But the Hull-Rust-Mahoning, with the adjacent workings, will in the meantime remain the largest of man-made pits.

Variety as a Corrective of Industrial Boredom

WHAT does the average worker do with his spare time, whether he be laborer, artisan, or salaried official? Few employers seem to take an interest in the subject, which is to be regretted, because the choice of a hobby is often indicative of character and efficiency and a desire to excel. Such a change of occupation may prevent the condition of industrial boredom that is aggravated by idleness and self-commiseration.

The division of each twenty-four hours into three shifts of eight hours apiece was the first logical step toward the mitigation of industrial fatigue. Next to the establishment of a rational period for recreation and rest comes the necessity of seeing that the conditions of work are as varied as possible. This is practicable in most instances in which the eight-hour shift is in vogue. Statistics show that the work of men who "change and change about" is as efficient as that of those who work only on the day shift. A regular change in the hours of work permits time and opportunity for recreation and leisure and for indulgence in hobbies.

Speaking at Columbia University recently, Professor D. G. Mason deplored the "useless speeding in motor cars from nowhere to nowhere . . . superlatives and exaggerations in talk . . . the feverish pumped-up gaiety of the 'wild party' . . . the thrills so insistently demanded . . . violent plastic arts, using harsh angles and garish colors . . . noisy, mechanical, overaccentuated music . . . a jaded, joyless age, incapable of the happy serenity of creative leisure." With optimism, he hopes for the day when boredom will be an "acknowledged index of stupidity."

Modern industrial conditions are favorable to the worker, but his success in life depends to a great extent on what he does with his spare time. So long as libraries are sparsely attended by readers, so long as ideas and impressions and achievements remain unrecorded and unpublished, opportunity remains for suggestion, encouragement, and reform.

Danger in Entering Abandoned Mines

EXPERIENCED MINING MEN usually understand the risk involved in entering old inactive mine workings and take precautions to secure proper ventilation beforehand, or at least to test cautiously for gas as workings are explored. The inexperienced should not enter such mines unless accompanied by some one who is competent to determine the safety of the place. A case in point is the recent death of two brothers who entered an abandoned or idle gold mine near Randsburg, Calif. After their failure to signal to the hoisting engineer who had lowered them into the mine, an investigation discovered the fatalities, which had resulted from their entrance into a gas pocket. One of the brothers is said to have been the mine superintendent and the other an electrician. Accidents of this kind are preventable by a comprehension of the possible danger in such situations.

BURMA—

An Important Source of Precious and Semi-Precious

GEMS

By ALLAN B. CALHOUN
Mine Manager, Burma Corporation, Ltd., Bawdwin, N.S.S., Burma

The golden Shwedagon pagoda—the greatest pagoda in the world

BURMA is a land of enchantment, both in country and people; and, moreover, it is a land of considerable wealth in natural resources. Included among such resources are: the great Bawdwin silver-lead-zinc mine, which produces monthly 6,500 tons of refined lead, 600,000 oz. of fine silver, 5,000 tons of zinc concentrates, and 1,000 tons of copper matte; the Yenangyaung oil fields, producing over 1,000,000 tons of oil per year; the famous ruby mines of Mogok, which during the last few years have supplied the world with 185,253 carats annually of beautiful rubies, sapphires and spinels; the jade mines of Upper Burma, which supply most of the valuable Chinese jade at the rate of 4,000 hundredweight per year; the amber mines in the Myitkyina district, which have an annual output of 31 hundredweight; and the tin mines of Tenasserim, which have produced 2,000 tons of tin concentrate per month and are rapidly increasing their output. Besides the minerals and precious and semi-precious stones, the great forests, which cover three-fifths of all Burma, supply teak and other less valuable hardwoods. Rice, however, is the great crop and revenue producer.

To the tourist who enters Burma, there are of interest the golden Shwedagon pagoda, the large reclining Buddha, and the trip up the Irrawaddy River to Mandalay, where King Mindoon's palace is situated, with its grounds one mile square surrounded by a moat. To know Burma better, however, one must leave the beaten track and go to the villages and mines. The first mines to see from Mandalay are the ruby mines of Mogok, which are situated close to the border of the semi-independent Shan states and are reached by taking the boat from Mandalay up the river to Thabekyin, a small town on the left bank of the river. This is a pleasant trip on one of the Irrawaddy Flotilla Company's steamers, requiring ten hours. At Thabeykin the visitor may stay in comfort at a government rest house or Dak bungalow, provided he has brought his own bedding and mosquito netting, and has learned that to travel without them in Burma is never done even in the best of society.

From Thabekyin one of the best motor roads in Burma extends 60 miles to the town of Mogok. It starts at the river, at a point 300 ft. above sea level, and rises to 4,000 ft. at Mogok, passing through delightful scenery. A regular motor service is maintained, which will land one in Mogok in a few hours, or at one of the delightful Dak bungalows on the way, where one may indulge in some of the finest big game hunting in the East.

Mogok is a small town of several thousand people situated in a valley among the mountains. Nearly all the inhabitants are engaged either in mining precious stones or in some industry connected with the cutting, polishing, or selling of the gems. To the east of Mogok, about 50 miles in an air line, lies the Bawdwin silver-lead-zinc mine, the largest high-grade mine of its kind, and one in which Herbert Hoover had a considerable interest during the early days of its organization. Tucked in among the mountains, the mine, with its mill, smelter, refinery, and small towns housing several hundred Europeans and 1,500 Burmese employees, is connected to civilization by a 2-ft.-gage private railway connecting with the meter-gage government railway at Nam-yao. To the north of Mogok lie the famous old tourmaline mines at the little village of Manyin, in the State of Momit, which borders on China. This state is my favorite hunting ground, and I visit it when the mine and other tropical worries bring on a grouch; and this I take out on the poor tusker.

Arriving at Mogok, one is confronted by the expanse

of a good-sized lake (one mile long and a quarter of a mile wide), with merrymakers plying their sampans (Burmese boats brought from the Irrawaddy River). On inquiry about the location of the old ruby mines, you will be informed that they are before you and that where the sampans are now skipping merrily about, thousands of Chinese coolies have toiled and propelled a wheelbarrow or car instead of a boat. The lake, which is 45 ft. or more in depth, is the abandoned pits of the old ruby mines, which are now filled with water. If you are still interested and will make inquiries from the old residents who have been there 20 or 30 years, you will be repaid for your trouble, as the vicissitudes of the Burma ruby mines are not to be envied.

Ruby Mines Date Back to Antiquity

Like diamond mining in India, which began perhaps in the time of Ptolemy, the early history of the ruby mines dates back to antiquity. Similarly, the Bawdwin mine was first worked in the 14th century. The earliest record with reference to the ruby mines goes back to the year 1597 A.D., when the Burmese king secured the mines from the Shan ruler. They were worked by his descendants intermittently to 1885, when the king entered negotiations to lease the ruby mines to a Paris firm for £2,000 a year. Negotiations were broken off by the annexation of Upper Burma by the British, and the mines leased to an English firm, Streeter & Company, in which the Rothschilds were interested.

The lease consisted of 400 square miles of rolling jungle country, and was being worked in a primitive manner by the natives. Some of the valley lands were used for growing paddy, and others for actual mining. Where the native was actually in possession, his prior right was upheld, and if the company wanted the land it had to settle with him. The actual area finally acquired and operated by the company was 10 by 20 miles.

Rubies Associated With Limestone

Rubies mined in the area are derived from crystalline limestone, on the contact of, or interbedded with, a complex series of gneissic rocks. The former occurs as thin layers of marble alternating with the latter. The gneissic rocks are highly foliated, whereas the limestone generally consists of large distorted and bent crystals. All of the series is intruded by veins of granite, possibly of the same age as the great mass of Tengpeng granite, which extends from the ruby mines to the

In the vicinity of the Shwedagon pagoda

Bawdwin mine, and which is, perhaps, the magma that supplied the plutonic and volcanic rocks in which that large orebody is located. The alluvial in which the rubies are actually found is derived from the aforesaid rocks and consists of disintegrated granite and marble accompanied by the typical contact minerals. It is 20 to 70 ft. deep, depending on whether it is on a hillside or in the valley, and is naturally richest at the bottom. Near the bottom, a layer of chocolate-colored clay will usually be found, and between it and the underlying eroded limestone is the commercial gravel, known locally as byon, which carries the gems.

The gravel is generally light colored, containing quartz, orthoclase, and calcite. When the byon is pure decomposed limestone, it contains usually first-class rubies and very few or no sapphires. In some places the rubies have been found embedded in the crystalline limestone, but as a rule these cannot be used for gems, as they are too soft and full of cracks; they can be valued only as chunks of pink or red corundum. Curiously, in some gravel the sapphire predominates and in others the ruby, and whether the degree of metamorphism causes the change in color, or whether this is caused by some other local condition in the stone, is questionable. They are of the same composition, hardness, crystallization, and specific gravity. When the color is red the crystal is called a ruby; but when blue or any other color, a sapphire. Generally both show the silk, and, although this is an aid in distinguishing the

A section of the town of Mogok, where ruby mining dates back to antiquity

genuine gems from the artificial and from other inferior stones, it is not always infallible, as some of the highest priced rubies have little or no silk.

The star ruby and sapphire are beautiful gems and cannot be imitated by synthetic means. Owing to the original crystals being hexagonal rhombohedrons, the stones when cut round or oval cabochon shape, with the center of the face at the exact center of the three axes of the hexagonal crystal, will have six definite lines or rays of light which show up as a star when viewed in reflected light.

Associated with the ruby and sapphire is red spinel. Some of these crystals are beautiful and lend themselves to be set in jewelry without any cutting. Their color varies from dark to almost transparent red. When one of good color with plenty of fire is obtained, cut, and set in a ring, it is extremely difficult to the layman to distinguish it from the ruby; consequently those of good color are sold as balas or spinel rubies.

The next mineral, in scale of hardness, found associated with the ruby is beryl in the form of aquamarine; this is a silicate, whereas the ruby sapphire and spinel are oxides. Green beryl, the emerald, however, is not found in Burma. Variable quantities of the following semi-precious stones are also found in association with the ruby: zircon, topaz, quartz crystal, amethyst, peridot, rock crystal, lapis lazuli, apatite, garnet, and tourmaline.

Mining Methods Employed

The primitive native method of working was to first select the ground and, if on a flat, to sink to bedrock a small vertical shaft 4 or 5 ft. square. This shaft is locally known as a twinlon. A license was granted permitting the lessee to mine the ruby earth or byon for a distance of five fathoms from the center of the shaft, and in special cases as large an area around the shaft as was considered safe. He was permitted to work as many men as he wished by paying a fee of Rs. 20, or £1¼, per month for each worker. The company collected this fee for the government at a 10 per cent commission and at one time had as many as 800 licenses in force.

The spoil was raised in baskets to the surface by bamboo hoists in much the same manner as the Oriental raises water. A typical device for hoisting consists of a bamboo, 40 or 50 ft. long, fixed in an upright position in the ground, to which is suspended another, equally long, with a bamboo rope and basket attached at one end and a counterpoise weight at the other. With these crude hoists the native was able to operate to a depth of 70 ft. Hoisted gravel was washed in baskets, the precious material thereby being separated from the barren. The good stones were then picked out by hand. This primitive type of mining could be done only during the dry season, on account of the large amount of water encountered in the valleys during the wet season. To see the valley covered with these primitive hoists or derricks a few feet apart is an interesting sight and reminds one of a closely drilled oil field on a primitive scale.

If the spot selected were on the hillside, a totally different system was employed. In this case a ditch was carried around the side of the hill to serve as a canal to bring water from some of the mountain streams. The alluvial was then washed down into sluices, where the heavy rich concentrate was separated out and finally treated in a long tom. This kind of mining could be carried on only during the wet season, when all the small nullahs have running streams, and when it is impossible to work the flats by the shaft method. This sluicing suits the Burman, as he is a great gambler and does not like hard manual work. All the hard work at the mines is done by the Chinese or Chinese-Shan.

The good stones are sent to London, or bought on the spot by representatives of American and European jewelers. Inferior stones are auctioned off to the highest bidder at £3 per viss (3½ lb.); this material goes to India and other countries to make cheap jewelry.

European Methods of Operation

Europeans, in first prospecting the district, expected to find another Kimberley, or, in other words, a volcanic pipe extending down to the interior containing rubies instead of diamonds. Consequently, most of the early work consisted in searching for this pipe, or in treating the alluvial by the Kimberley process. However, no pipe was discovered, and as it was found uneconomical to have the work scattered, with small mills here and there, they decided to mine the entire valley alluvial on a large scale. The Burmese had never been able to reach bedrock in the lower parts of the valley, on account of the large amount of water encountered. The company was compelled to purchase a large part of this area from the people of the region, as the land the latter could not mine they had cultivated for rice. A start was made in Mogok valley in virgin ground, and the system employed was as follows:

Pits 10 ft. square and 25 ft. deep were sunk in the alluvial, and centrifugal pumps installed to get rid of the water. The surrounding ground was then excavated by pick and shovel, and hauled in trucks up an incline to the washer. In a short time the pits would become connected and the excavation would resemble a huge quarry. When the lowest level of the quarry was nearly down to the bottom of the pits, the latter were sunk another lift of 25 ft., or to bedrock, provided the pump could handle the water. Excavating was then resumed to a lower level. As the operations increased, so did the water, until in 1894 the pumping plant had increased to five 12-in. centrifugal pumps having a capacity of 5,000 gal. a minute. During the period of January, 1895, to February, 1904, stones to the value of Rs. 7,280,000, or £485,333, were extracted at a cost of Rs. 3,000,000, or £200,000.

To mine some of the deeper alluvials close to the town of Mogok, however, it was necessary to devise a different system, as the cost of pumping there would have been prohibitive. A drainage tunnel 7x7 ft. and 5,400 ft. long was driven to tap the bottom of the valley. When completed, mining was started on a larger scale by quarrying and raising the material by incline to the washer. The alluvial was broken down with monitors working at a pressure of 100 to 250 lb. per square inch. Material was then raised by hydraulic elevators or gravel pumps to the sluices. Mining costs totaled 8 annas, or 8 pence, per ton, and the gravel had an average value of 12 annas, or one shilling, per ton.

Treatment Operations

The dirt brought up the incline was dumped into a revolving screen, where it was disintegrated, and then discharged into a 14-ft. diameter washing pan similar to the Kimberley pan. Here the ground was washed by revolving arms equipped with long teeth, the overflow passing into a safety pan and the remainder, which

consisted of a concentrate of precious stones and other heavy material, being periodically drawn off and sent to the sorting house.

At the present time a hydraulic system is in use. The ground is raised by gravel pumps to sluices and is then passed over a screen; the fine material, 2 in. and under, passes into a 10x60-ft. sluice box, where the concentrates are caught on riffles. These concentrates are cleaned up at intervals and carried to the sorting house. Sorting of the concentrates from the washers and the sluices is done by coolies in wire masks under a guard of Gurkhas with European supervision. The concentrates are put through revolving screens of different sizes and then into a pulsator and panned until the rubies and other valuable stones are on the bottom. The pan is then turned upside down and the good stones are picked out. Although the coolie wears a wire mask and is watched by the Gurkhas and Europeans, he nevertheless manages to purloin some good stones. The tailing goes outside the fence, where women, who have acquired a hereditary right, sort it over and pick out small rubies and other stones of some value.

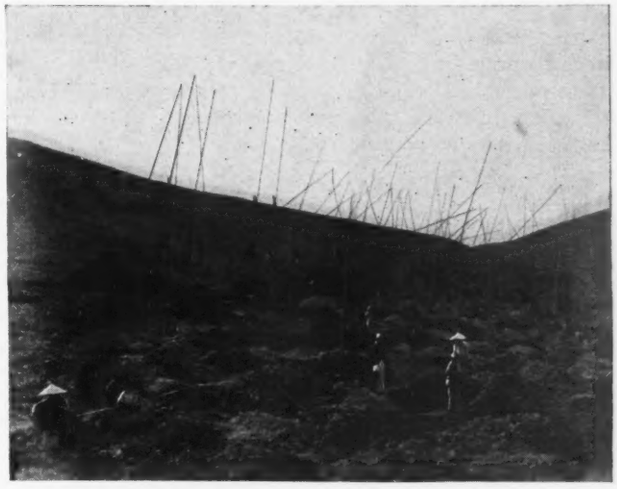
Determination of Gems Not Easy

To facilitate the determination of rubies in the field, a thallium silver nitrate solution in water, having a specific gravity of 4, is prepared and carried in a small vial in the vest pocket. Any stone that floats on this solution is not a ruby, as the latter will just sink in the solution. The diochroscope is a tiny and inexpensive instrument which can also be carried in the pocket. By holding the stone with a pair of tweezers before the lens of the diochroscope, two images of the stone will be seen side by side. If the position of the stone is then rotated so that different planes of the crystal come into view, the images will change color from pink to deep red in case of the ruby, whereas the color in the case of spinel and garnet will remain unchanged. Red tourmaline or rubellite also shows the variation in color, but a difference in specific gravity and hardness from the ruby will aid in making the determination.

Without the aid of the diochroscope one can obtain similar results with a white card. Place the gem in the direct sunlight and hold a white card a few inches from it in direction of the light so as to get as bright a reflection as possible from the stone on to the card. If the stone is a ruby a double image of the reflecting surface will appear, and, if the stone is turned, these pairs of reflections will stay together and not separate. This behavior is caused by the fact that the crystal is a double-refracting one. Diamond, spinel, and garnet would give but a single image, as they are single-refracting crystals. A more expensive instrument which will determine quickly and accurately the character of any stone is the refractometer. This instrument determines the index of refraction of the stone, and on comparing the index obtained from an examination with a carefully prepared table accompanying the instrument, the name of the stone examined is identified.

All the aforesaid methods will aid in differentiating the various stones from one another, but not from the synthetic ones, as the latter are now made with all the optical characteristics of the genuine. With a little practice it is not difficult to tell the genuine stone in the rough, but only one skilled in the business can tell at a glance a genuine cut stone from the synthetic, and as a rule the aid of a microscope is necessary.

The instrument most used and the only one of real value in gem determination is the microscope with 1-in. or ½-in. objective. With this instrument the structure, shape, and arrangement of the bubbles inclosed in a gem can be determined; spherical bubbles and a wavy concentric structure signify a synthetic stone; angular bubbles and striations the genuine stone. The synthetic stone appears clearer and altogether a more perfect stone; whereas the genuine is seldom free from some flaw or blemish. Striated structure in the genuine gives a sheen or silky lustre when viewed by reflected light at certain angles. The real stone is seldom perfectly round, but is slightly elongated, whereas the synthetic is generally circular.



Natives working the Mogok alluvials with twinlons and bamboo hoists

Genuine stones that are often passed as rubies are the spinel, called the balas or spinel ruby; the garnet, called the Cape ruby; and the red tourmaline, called rubellite. These are not difficult to determine in the rough, as the crystals are of entirely different shape, and, when cut, one of the simple methods already mentioned should make the determination easy. It is the synthetic stone that will often try one's patience. These stones are made by starting with a small fragment of ruby or amorphous alumina, which is heated to a white heat in the flame of an oxy-hydrogen blowpipe and then gradually built up by injecting finely pulverized ruby dust. The fusion takes about two and one-half hours. A powder of alumina and chromium is prepared for coloring the ruby, and one of alumina, 1.5 per cent ferric oxide, and 0.5 per cent tannic acid for coloring the sapphire. Yellow colors are produced by oxide of nickel. By a secret process the fused drop becomes a crystalline body and not simply a fused mass of alumina or an aggregate of crystalline fragments. The drops on cooling split or are divided longitudinally into halves, which are suitable for cutting into stones. These synthetic stones have double refraction and the same hardness and specific gravity as the genuine, and the only means of determining their character is the microscope. A certain celebrated German geologist who spent over a month examining the ruby mines at Mogok during the early part of 1928 said that in Germany ruby crystals up to ½ in. in diameter are now being actually grown from solutions, as in nature. Under these circumstances I doubt whether one will be able to distinguish the dif-

ference between the ones grown in the laboratory and the ones produced by nature.

A large proportion of what is known on the market as Chinese jade, especially the mauve and emerald green varieties, comes from Burma. These beautiful varieties are not true jade but a similar stone, heavier, harder, and more beautiful, called jadeite. It was found as early as the thirteenth century in the unadministered territory of Hukong, on the Upper Chindwin River in the Myitkyina district of Upper Burma. Until recently the deposits were worked in a primitive way by the natives and their slaves and also by the Chinese who were permitted to enter the territory. The jadeite occurs in boulders in alluvial deposits of conglomerate and clay and also in place as a metamorphosed igneous dike intruded into serpentine rocks.

Methods of Chinese Jade Mining

Pits were sunk to the rock in place and large excavations made to expose the surface of the rock. Where indications appeared favorable, large fires were started on top of the rock, and, when sufficiently hot, pieces were split off by suddenly cooling with water. If a piece showed good color, or the possibility of containing such in its interior, it was transported to Mogaung on the river. This is the gambling market for the stone. Here it is auctioned off to the Chinese traders who are willing to take a chance on the piece of stone containing valuable color. It is then transported to China by pack animals or rafted down the river to Mandalay. Recently more modern methods employing machine drills and explosives were introduced in quarrying the rock.

The purchase of a large boulder or piece of quarried rock is a big gamble, as the Chinese trader, who must pay £13 to £17 per hundredweight for the boulder, does not know until it is rafted to Mandalay and sawn into pieces whether it contains good color or not. The beautiful green color generally runs in streaks throughout the rock.

Although exceedingly hard and tough, a primitive method is employed at Mandalay in cutting the rock. A small twisted silver cord or cable is strung on a bamboo bow, and, with a man on each end, is used as a saw. The silver cord is fed with emery, corundum, or spinel dust from Mogok, which dust becomes entrapped in the cord and actually does the cutting. The operation is watched with considerable interest, as the sawn face will determine what quantity, if any, of valuable stone the rock contains. The good portions are sawn out and shipped to China, where they are cut and polished into various beautiful ornaments and sold as Chinese jade. Some jade is also cut and polished in Mandalay, and beautiful necklaces can be obtained at reasonable prices, especially of the mauve color. Beautiful green beads of good color, however, are quite expensive.

Amber Found With Clay and Lignite

Amber is found in the Hukong valley not far from the jade mines. It is associated with the blue clay and lignite of probable Miocene age and is supposed to be the resinous droppings from trees in former tropical forests. Later these forests became buried and the resin was covered by later beds; the period involved would probably extend over millions of years. The amber is found by sinking small shafts 20 to 40 ft. deep and then joining them up in the blue or amber-bearing clay. Many different kinds of chunks are obtained, but only the clear transparent variety is of value. This is quite hard, takes a good polish, and is fit for carving and turning. The Chinaman values the deep brown variety of amber and believes that when the tiger dies its soul penetrates into the earth and becomes the stone amber. Production from 1914 to 1918 amounted to 18.4 hundredweight.

A fair quantity of amber of different kinds is found in the district; some of it is clear, some dense and cemented by calcite. The former is the only kind used for ornaments, as the process of preparing the other material for market is not known to the Burmese, and consequently Burma amber must compete with cheap material of the Baltic Coast, which is under the control of the German government. Some amber is found in Rumania, Sicily, and Lithuania, but in small amounts as compared to the Baltic fields, where amber-bearing beds 20 ft. thick are worked. Burma amber not only competes with the cheaper genuine amber from Germany but also with the reconstructed amber and imitations commonly found on the market.

Hydrogen Ion Concentration Affects Flotation of All Minerals

CHANGES in hydrogen ion concentration have an effect on the recovery of all minerals by almost all reagents. The U. S. Bureau of Mines has found this to be a fact, as a result of further research on the fundamentals of flotation conducted jointly by the Intermountain Experiment Station of the Bureau and the department of mining and metallurgical research of the University of Utah, Salt Lake City. The following facts were disclosed:

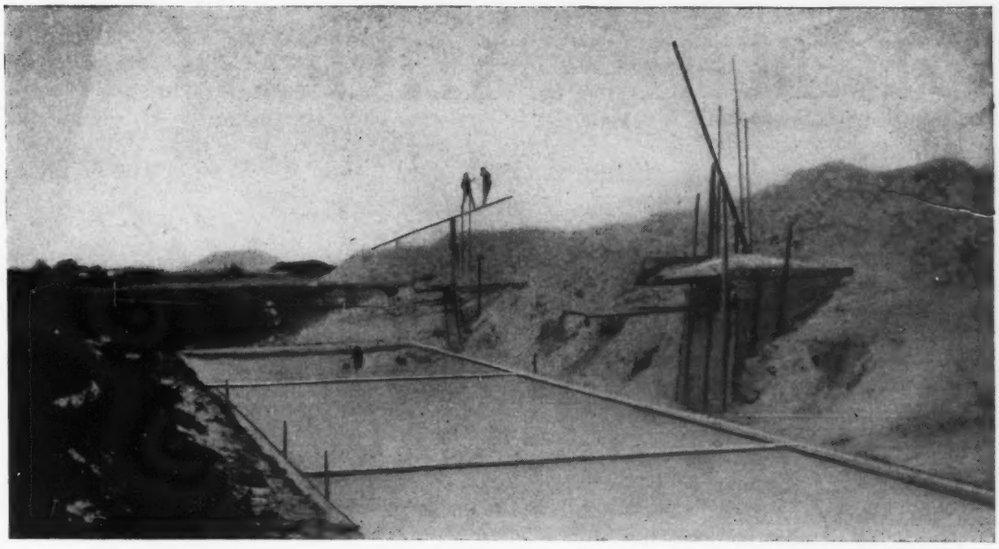
Sphalerite is not floated by any of the usual collectors unless it is first altered at its surface to copper sulphide, lead sulphide, mercury sulphide, silver sulphide, or cadmium sulphide, through the action of soluble salts of the respective metals.

A few selective collectors for unactivated sphalerite have, however, been found. The most powerful of these collectors has been called "zinco," because of its peculiar property of floating sphalerite in the unactivated condition.

Changes in hydrogen ion concentration have an effect on the recovery of all minerals by almost all reagents. This has been found to be attributable to one of two causes: (a) Reaction between the mineral surface and the solvated (or hydrated) ions in the solution (by adsorption, or by chemical action); (b) reaction between the hydrogen ions and the reagent, resulting in difference in the ease with which a reagent gathers at the surface of the minerals at different pH's.

In spite of considerable work and apparently promising results, little success has been achieved in separating quartz from feldspar, although this is not to be construed to mean that no separation whatever was obtained. Starting with a 50-50 mixture, the best results yielded products containing approximately three-quarters of one mineral and one-quarter of the other. It appears that this is due to reaction between the minerals that is going on through the medium of solution of the constituents of the two minerals, so that after a short time their surfaces have become identical.

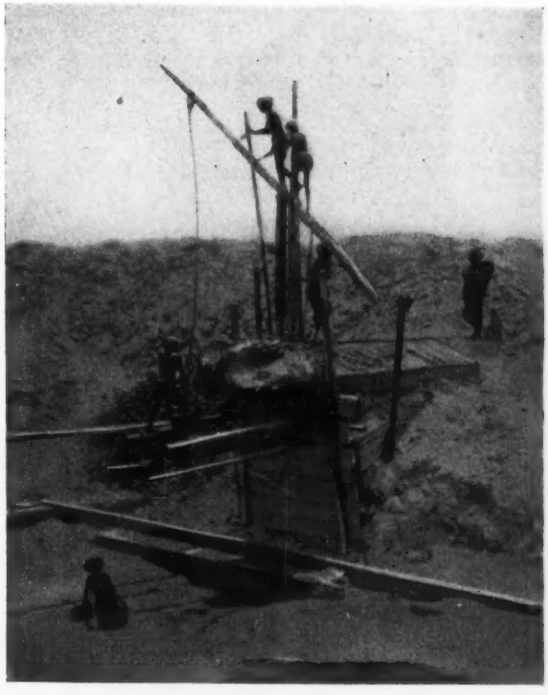
Silica and silicates remove metal salts from solution (possibly by base-exchange adsorption).



Gold ore slime from the battery was settled in rectangular vats, and the clear water decanted. The next step in the process was the utilization of a human elevator

The High Cost of "Cheap" Labor

MODERN continuous thickeners and diaphragm pumps have replaced this primitive system of ore-slime settlement and elevation at a mining property in India. Dorr thickeners now do the job automatically, producing a thickened pulp of even consistence and at a regular rate of flow.



An Indian woman stood waist deep in the slime and filled the bucket, which was then raised by the movement of the two natives along the beam

How the bucket of ore slime was dumped

Starting Andes Copper's *Electrolytic and Refining Plant*

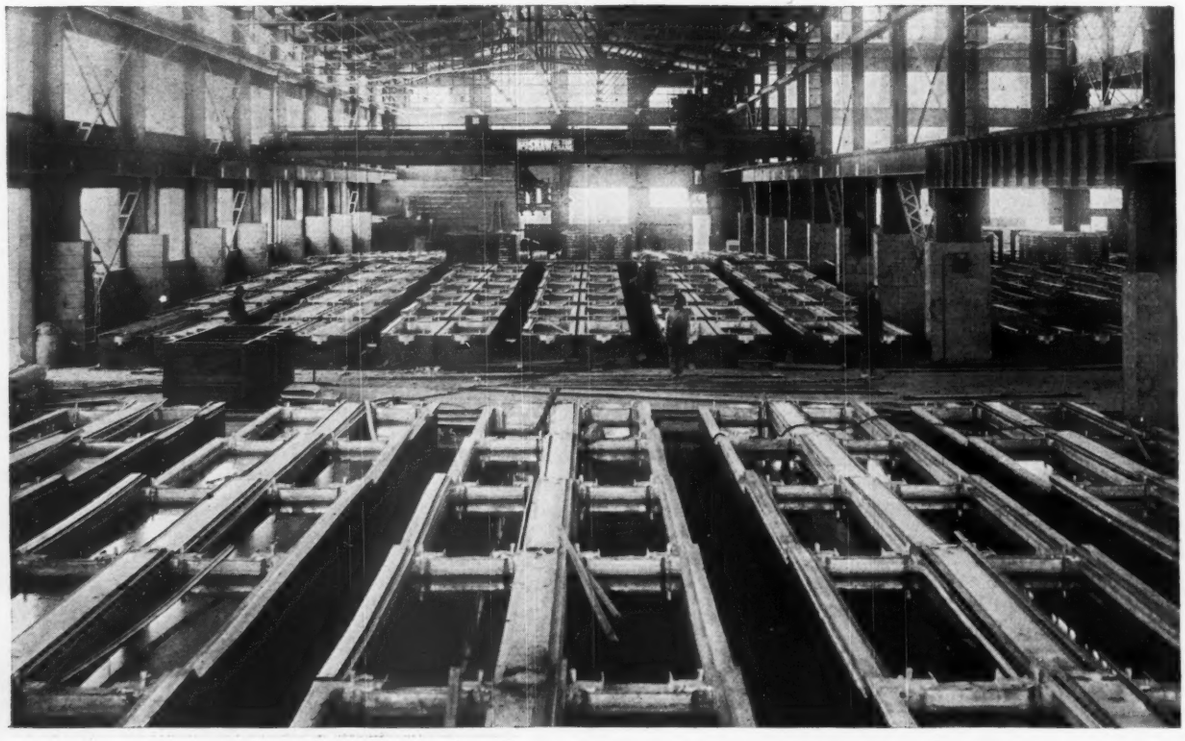
By Carr B. Neel

THE electrolytic and refining plants of the Andes Copper Mining Company are situated at Potrerillos, Chile, about 94 miles from the coast at an elevation of 9,500 ft. Operations began the latter part of July, 1928. The electrolytic plant is housed in a steel building with a concrete basement the floor of which is of brick laid in and covered with asphalt. It drains to a central gutter carrying any solution or wash waters to the wells of two sump pumps from which such solutions may be pumped to the receiving tanks in the basement or wasted through two circular pits connected to the exterior by tile drains. In addition to the receiving tanks, the basement contains the splitting tanks, emergency tank, air-lift wells, two spent-electrolyte pumps, two sump pumps, the cathode wash-water pump, and the main busbars carrying the electric current to and from the cells. The cell room and columns above are supported by piers in the basement. All walls and piers are painted with a mixture of 60 per cent asphalt, by volume, and 40 per cent fuel oil, applied hot and subsequently whitewashed.

The steel building is 192 ft. wide by 302½ ft. long, divided longitudinally into three bays, each served by a 10-ton, overhead, direct-current crane. Transversely, each bay is divided into three divisions by wooden platforms carrying tracks or electrolytic cells.

Adjoining the electrolytic plant is the substation, 40x141 ft., containing four motor-generator sets. Each set comprises one motor driving two generators, one on each side of the motor and on the same shaft. Each d.c. generator is capable of delivering 3,750 amperes at 425 volts. There are three electrical circuits in the

Interior of the electrolytic department while under construction in January, 1928, showing the six cells in cascade, twelve rows abreast in a circuit.



General view of the Andes reduction plants at Potrerillos. The smelter is seen in the background, with the leaching vats in front. To the left is the electrolytic precipitation department, and further to the left is the townsite.

THE MOST RECENT *of the large Chilean copper developments to attain production is that of the Andes Copper Mining Company, whose reduction plants are at Potrerillos, 94 miles from the coast, at an altitude of 9,500 ft. The Chuquicamata enterprise of the Chile Copper Company is about 300 miles to the north and the Braden property a little over 500 miles to the south. Active producing operations at the leaching, precipitating, and refining plants at Potrerillos began the latter part of July, 1928, In addition, a smelter is provided for treating sulphide ore. The accompanying discussion is confined to the equipment, arrangement, and early practice in the electrolytic department where the leach solutions are precipitated, with brief mention of the breaking in of the refining furnace.*

electrolytic department for the deposition of copper, one set supplying the current for one circuit, and the fourth set being a spare.

The three commercial circuits use insoluble anodes. Each circuit is divided into three divisions and contains 192 cells. To either of two circuits, the starting-sheet division can be electrically connected. In general, this department is patterned after that at Great Falls, Mont.

The 576 cells in the commercial divisions and the 54 in the starting-sheet division are built of reinforced concrete, painted with asphalt paint, and lined with one-eighth inch lead carrying 6 per cent antimony. Their inside dimensions are 10 ft. 3 in. long, 2 ft. 10 in. wide and 3 ft. 9 in. deep; and the outside dimensions are 10 ft. 11 in. long, 3 ft. 8 in. wide and 4 ft. 1 in. deep. In their construction, six steel forms, manufactured in the United States, were used.

In the process of construction, the concrete mixture used was $1\frac{1}{4}:2:4$. To this was added $7\frac{1}{2}$ gal. of water for a batch of $7\frac{1}{4}$ cu.ft., mixing this for 3 min. This concrete permitted stripping the forms from the cells in 21 hours, even in freezing weather, and the cells could be lifted by the four iron bolts imbedded in the corners of the concrete, and shifted to the piers, in $4\frac{1}{2}$ days. As the weather grew warmer, they could be lifted in $3\frac{1}{4}$ days when necessity required. As the schedule called for six cells per day, and as the space on the casting platform was limited, they had to be moved within this period.

The cells were painted with the same mixture used on the basement walls and piers: 60 per cent asphalt and 40 per cent fuel oil, applied hot. When a greater percentage of asphalt was used, the paint was harder to apply, but it would have been better to use more asphalt, as the 60:40 mixture was soft enough to creep where the sun struck it and in the starting-sheet division where the electrolyte was heated. In applying this paint, it was found desirable to allow the cells at least twelve days to dry before painting with the hot paint, as otherwise sufficient moisture remained near the surface of the concrete to form steam, thus making blowholes in the paint. To paint a cell inside and out required $9\frac{2}{3}$ gal. All the other vessels in this department are of wood lined with sheet lead containing 6 per cent antimony.

The concrete cells are supported on concrete piers and arranged in cascades of six cells in a flight, two flights to a section. There is a drop of 4 in. between the cells, or 20 in. in a cascade of six. Between each section is a wooden walkway. In six of the nine divisions there are six sections each, but in the last three divisions, one in each circuit, there are only four sections each, the object

being to increase the rapidity of flow of the electrolyte in the division where the copper content is lowest. In the starting-sheet division there are 4½ sections, or 54 cells.

Electrically, the 192 cells of a commercial circuit are connected in series, with the electrodes in each cell in multiple. To either of two electrical circuits the 54 cells of the starting-sheet division may be connected in series with the commercial units.

From the storage tanks the copper solution passes into a small regulating tank of a capacity of 36 volumetric tons (a volumetric ton is 240 gal., occupying 32 cu.ft.) through a float valve. This float valve keeps the head of solution in the regulating tank constant, and permits regulating the flow into the measuring boxes or delivery tanks more closely. The solution arriving at the electrolytic plant is there mixed with approximately one-half its volume of spent electrolyte, and with sulphuric acid, which mixture forms the electrolyte.

Following are average analyses, over one month, of the fresh and spent electrolyte, expressed in grams per liter:

	Electrolyte	Spent Electrolyte
Copper	42.03	11.9
Sulphuric acid	9.74	66.2
Total iron	0.67	0.68
Ferric iron	trace	0.60
Aluminum	1.80	1.84
Arsenic	0.41	0.51
Antimony	0.004	0.029
Phosphorus pentoxide	0.20	0.21
Manganese	0.16	0.16
Molybdenum	0.05	0.07
Dissolved silica	0.40	0.32
Chlorine	0.11	0.08
Nitric acid	0.25	0.15

The Starting-Sheet Division and Its Early Operation

The starting-sheet division takes the unmixed electrolyte as needed. It operates in a closed circuit and takes only enough fresh electrolyte to make up for any that may be discarded to the commercial divisions in order to keep down the impurities that accumulate in the starting-sheet electrolyte. It is heated by passing live steam through coils of 1½-in. lead pipe 148 ft. long. The temperature of the electrolyte is raised to 60 deg. C. in the delivery tank. As it flows down the cascade, the temperature drops 10 to 12 deg. or more in cold weather.

In this division the 54 cells are at the south end of the central bay. They differ from the commercial cells in that they have, first, a lead wash-out plug in the center of the bottom to assist in the removal of the anode mud from the soluble anodes; second, a slight bevel at the inlet end under the spout of the preceding cell; and third, smaller spouts.

At times difficulty has been encountered at some plants in securing good starting sheets at the beginning of operations, and as it was desired here to get a reserve stock of starting sheets on hand, plans were made to start this division as early as possible, so that any troubles might be eliminated with a minimum of delay in the main plant.

As designed, the starting-sheet division was supposed to run only when connected in series to a commercial circuit, so the generators had been designed for a minimum voltage of 45 volts. As it was decided to run only a maximum of three sections and, at the start, to run four cells or fewer, the maximum resistance for the three sections would require a pressure of only 15 volts to overcome it, and less when fewer tanks were in service. To keep the consumption of power as low as possible, the commercial divisions were cut out and the starting-sheet division was connected directly with the generators of one motor set. It was now necessary to reduce the voltage at the generators. Mr. Bell, of the electrical department, cleverly solved this by connecting the fields of the two generators in series, thus cutting the voltage in half, and, next, by putting all the resistance available in the exciter field, cutting its voltage in half. He was able to do this because the motor was running at so light a load. This then enabled the voltage at the generator to be cut to about 11 volts instead of the minimum 45 volts for which it was designed. Now, however, it was difficult to make the two generators run in balance, as one generator would rob the other. Mr. Bell overcame this by putting in resistances in the form of lamps in parallel with the field circuits of the generators; then, by screwing in or taking out the lamps, the load on each generator was equalized. We also used a water rheostat connected in series with the operating cells in order to get sufficient resistance.

Solving the Glue Problem

One of the points that caused some bother in starting was the determination of the proper amount of glue in the electrolyte of the starting-sheet division. Figures from several plants were available as to the proper amount to add daily when operating, but no data were available as to the amount required in the electrolyte to bring it to the proper condition which would permit satisfactory starting sheets in the first place. Through the courtesy of the Chile Copper Company, determinations were made by the technicians of that company on their starting-sheet electrolyte, the glue in which was found to be approximately 0.3 gram per liter. This information was found very helpful.

Because the starting-sheet blanks were valuable, great care was exercised to avoid spoiling any. Accordingly, only a few were placed in one cell at the start, the remainder of the cell, as well as the rest of the cells of the section, being filled out with starting sheets from the Chile Copper Company. The first section of 12 cells contained about 30 volumetric tons of electrolyte and about 10 more tons were in the delivery and receiving tanks, or 40 tons in all. In the first six days 24 lb. of glue was added to these 40 tons of solution, and this did not prove too much. When the next section of 12 cells containing 30 tons of electrolyte was started, 20 lb. of glue was added that day. After the necessary amount of glue had been added to the electrolyte to bring it to the proper condition, the addition of 3 lb. more per day for three sections containing 100 volumetric tons was found to give good sheets.

At first the glue was added by dissolving it in a tank holding 50 gal. of water, heated by steam coils. The dissolved glue was allowed to drip slowly into the receiving tank. Subsequently the glue was put in small perforated lead inclosures with no bottom, which were placed on the outlet spouts of the last cells in the cascades. The warm electrolyte dissolved the glue easily, and this was the easiest way to handle it.

Preparing the Starting-Sheet Blanks

The starting-sheet blanks are of rolled copper with grooves milled out on the bottom edge and close to the side edges on both sides, giving a trimmed starting sheet 28x37 in. This weighed 7 lb. or more for a 24-hour deposit at a current density of 18 amp. per square inch. The over-all dimensions of the blank were 28¾x43⅛ in.

At the top were riveted two supporting bars of copper, one on each side of the blank. After the bars were riveted, the joints were closed by dipping them in melted solder.

Amalgamation Technique

As the amalgamated surface of a blank tarnishes after 24 hours, it is desirable to place the prepared blank in service as soon after amalgamation as practicable. After a deposit of copper has been formed on the blank, it can be set aside for an indefinite period. However, as the first starting sheets formed on a new blank are light and hard to strip, each blank was stripped about four times before such blanks were set aside with starting sheets on them.

Accordingly each day only such number of blanks were amalgamated as could be handled promptly; these amalgamated blanks, after oiling, were soon placed in service. After the first few days, when only a few blanks were placed in the cells each day, twelve blanks at a time or multiples thereof would be prepared, thus giving a rack-full at a time, or half cell of blanks. These blanks would then be placed in the stripping rack, oiled, lifted by the crane, and placed in a cell. Half the blanks of a cell were changed at one time, the other half carrying the current, as the current was not shunted past the cells being stripped, as was done in the commercial divisions. At the start, in order to carry the electric current, starting sheets purchased from the Chile Copper Company were used to fill out the cells where blanks were not in service, as has already been mentioned. These starting sheets were replaced by blanks as fast as the blanks were amalgamated. When one section was filled by the prepared blanks, in the next section would then be placed those blanks that had been stripped four times and on which full-weight starting sheets had been deposited. In this way the blanks were prepared for the entire division and there was no difficulty in stripping such blanks when a new section was started.

Altogether 1,350 blanks were amalgamated, which consumed two carboys of nitric acid, weighing 132 lb. each, and one flask of mercury, weighing 75 lb.

At first, a cell contained 25 starting-sheet blanks and 24 soluble converter copper anodes. The hot electrolyte impinged on the first blanks in a cell, particularly in the first cell of a cascade, and corroded it. Oiling this blank was tried, using a mixture of cup grease and oil on the side on which the solution impinged, but this was washed away and deposited on other blanks in the cell, causing poor deposits and worthless sheets. A commercial asphalt paint was then tried, which also did not stand up. Lastly, pure asphalt was melted and applied hot. Though this gave the best results, it had to be discarded, as it softened in spots and was washed away. Finally those responsible for operations decided to take out the first blank in the cell and move a soluble anode into its place, so the present practice is to use 25 anodes and 24 blanks in a cell.

To prevent shorts as far as possible at the start and the possible damage of the blanks, grooved sticks were used to cover the edges of the blanks. These were subsequently discarded as the men became broken in.

Making the Starting Sheets

In stripping, the procedure followed by the Chile Copper Company at Chuquicamata was adopted. Half of the blanks of a cell are lifted at a time by the crane and transferred to a stripping rack. The top of the sheet is loosened by a chisel-shaped piece of steel bent in the form of a hook, and the loosened sheet was first removed by passing a round steel bar between the starting sheet and the blank until a wooden bar was suggested instead of the steel one, to prevent the scratching of the blanks, a change that was found advantageous.

To cause as complete a change of the electrolyte in a cell as possible, lead baffle plates are used at the outflow end. These baffles at first extended to within 9 in. of the bottom, whereas the bottom of the soluble anodes was only 5 in. from the bottom of the cell. In consequence, the lower 4 in. of some of the starting sheets were brittle and poor. This was overcome by extending the baffle 4 in. deeper.

The first starting sheets were made on July 15, 1928, and in the first three months the following results were obtained:

	July	Aug.	Sept.
Good starting sheets made	7,613	22,850	25,246
Percentage of good sheets	93.1	97.4	95.4
Ampere efficiency, per cent	90	91.9	92
Pounds of copper per kilowatt-day	112	171	166
Current density, amp. per square foot	17.9	14.1	15.4
Average weight of good sheets, pounds	7.4	7.6	7.8

During August and September, the three sections of the starting, sheet division were run only at part capacity. In running at from half to three-quarters of the normal density of 17½ amp. per square foot the starting sheets made were as satisfactory as those made at full density, provided there were no interruptions in the electrical current during the first few hours after placing the blanks in the cells. If a blank is placed in a cell which is not under current, the warm electrolyte washes away the protective coating of oil, and then, when the current is turned on, the deposited copper sticks to the blank, necessitating its being chiseled off.

The quality of the starting sheets made was high. Most of them had no pinholes, and those tested for imperviousness under varying heads of water from 3 to 18 in. showed no leaks.

The starting sheets assayed as follows:

	Per Cent		Per Cent
Copper	99.961	Antimony	0.0007
Iron	0.0025	Sulphur	0.0020
Chlorine	0.0036	Silver	none
Arsenic	0.0008		

A monthly average analysis of the electrolyte in the starting-sheet division ran in grams per liter:

Copper	41.2	Nitric acid	0.15
Sulphuric acid	107.6	Arsenic	1.10
Iron	0.92	Antimony	0.078
Chlorine	0.08		

The electrolyte was circulated at the rate of about 12 g.p.m. per tank. To this was added 3 lb. of glue per day for 100 volumetric tons of solution. In heating this electrolyte to 60 deg. C., approximately 9 volumetric tons per day was lost by evaporation out of the 100 tons circulating.

The soluble anodes used were made from the converter copper of the sulphide department, blown to a gas finish. They were cast in the converter plant, straightened, placed in the anode car, and brought to the electrolytic department after being weighed. A little difficulty with them was experienced at the start, as the under side of the lugs was cast with a bevel instead of square, making the anodes hang out of plumb and so causing shorts in the tanks. They weighed from 500 to 550 lb. each. Their analysis approximated, in per cent:

Copper	99.25	Arsenic	0.041
Sulphur	0.49	Antimony	0.002
Iron	0.048		

About 29 per cent scrap was produced from these anodes, exclusive of the anode mud. The weight of the copper in the anode mud is about 3 per cent of the weight of the anode scrap.

Practice in the Commercial Divisions

The strong solution from the dechloridizing plant, carrying about 40 grams per liter of copper, is received in the electrolytic department in weir measuring boxes and is there mixed with enough sulphuric acid to raise the acid content of the electrolyte to from 40 to 55 grams per liter at the delivery tank, the amount of acid added being determined by the requirements of the leaching plant. Acidified solution flows to the receiving tank below, where it is mixed with 50 per cent of its volume of spent electrolyte carrying 12 grams of copper per liter and 65 to 80 of acid. The composition of the electrolyte is regulated so that it will have a copper content of approximately 30 grams per liter at the delivery tank.

From the receiving tank, the mixture is raised by air lifts to the delivery cells above. From the delivery cell, the electrolyte flows through a manifold and riser, to the top refining cells of each of the twelve cascades of the first division of a circuit. The electrolyte passes down the six cells of a cascade, is collected in a launder, and delivered through a 6-in. lead line to the receiving tank of the next division, from which it is lifted to the delivery tank above. Again, it is distributed among the twelve top cells of the second series of cascades, passes through six cells in series, and then to another receiving tank. Similarly handled, the electrolyte flows through the six cells of the last division, the only difference being that the last division in each circuit has only four sections instead of the six sections of the first two divisions. This reduction in the number of sections through which the electrolyte flows causes a corresponding increase in the rate of flow in the last division. The electrolyte thus passes through eighteen cells in series and loses about one gram of copper per liter in each as it passes through—slightly more in the cells of the first two divisions and slightly less in the last division.

Spent electrolyte from the last division goes to a splitting tank, where it is divided, and approximately one-third is returned to the electrolytic circuit and the other two-thirds is pumped up to the leaching plant. The flow rate of the electrolyte is about 25 g.p.m. per cell in the first two divisions of a circuit and 37 g.p.m. in the last division, when running at the full current density of 13 amp. per square foot.

Each of the three circuits of the commercial cells is divided into three divisions. The first two divisions of a circuit have 72 cells each, whereas the last division has 48. These commercial cells each contain 34 insoluble anodes and 33 starting sheets, spaced at 3½-in. centers. The ten-day cathode made at the full density of 13 amp. per square foot contains about 100 lb. of deposited copper.

In pulling the copper, a unit of four cells is cut out at a time by means of short jumper bars, after which the cathodes are lifted out by the crane, one cell at a time, washed in a spray tank, and unloaded on to the cathode loading car. This car has two upright arms, which catch the cathodes as the crane passes up the bay, sliding them from the crane rack. The car is then tilted over—that is, the upper part carrying the tilting platform—until the arms are slightly below the horizontal. This deposits the load of cathodes on the cars of the industrial railroad which runs to the refining or casting plant. The cathode car is then pushed back by an air piston until its arms are clear of the loaded car and its platform is returned to its normal position.

On its return, the crane picks up a load of straightened and slightly corrugated starting sheets and drops them in the cell from which the cathodes have just been removed. The starting sheets are straightened on an iron rack having diagonal ribs on it, the purpose of the ribs being to form grooves in the starting sheet, thus making the sheets stiffer and less liable to curl in the cells.

As considerable gas is formed in the commercial divisions, making inspection and other work around the cells unpleasant, experiments were made with the use of oil to cover the surface of the electrolyte, thus keeping down the fine mist thrown off by the gas formed when operating. First, that used at the plants of the Inspiration and New Cornelia companies was tried. Under low current densities, it worked fairly well, but when the current density was raised to 13 amp. per square foot or over, the oil dissipated rapidly. Various other oils were tried with more or less success, the best results being obtained by the use of ordinary California fuel oil, but the practice of using a covering oil has since been discontinued.

As the electrolyte falls from the outlet spout of one cell into the one below, a downward current is created which entrapped the covering oil and carried it to the bottom of the cell. Part of this oil as it rose to the surface clung to the surface of the cathodes, resulting in a loose and spotty deposit. By placing dams around the inflow—the dams extending a short distance only below the surface of the electrolyte—the oil on the surface was kept from flowing under the incoming stream, so this difficulty was overcome while the oil was being used.

One circuit of the commercial divisions was started during the first part of August, at which time the starting-sheet division was electrically connected to this circuit in order to save power.

The following results were obtained during the first three months of operation:

	Aug.	Sept.	Oct.
Ampere efficiency, per cent	90.7	91	90.7
Pounds copper per kilowatt-day	27.5	29	28.8

The cathodes produced averaged: copper 99.85 per cent; arsenic, 0.0008; antimony, 0.0007; and chlorine, 0.003 per cent.

Insoluble Anodes

The insoluble anodes, of which about 20,000 were required, were made on the ground. They were cast from melted pigs of lead which carried 15.5 per cent of antimony, 1.7 per cent of arsenic, and 0.5 per cent of copper. These pigs were melted in pots holding 15 tons, and the melted material was run directly into the molds, of which there were four, held nearly vertically, revolving around a vertical axis. These molds were cooled by jets of air from perforated pipes, but when this was not sufficient, water was sprinkled on them. After the men were broken in, over 200 anodes was a fair average per shift of eight hours, the best shift's output being 281 anodes and the best day's run, 737 anodes.

A certain amount of care was necessary in the pouring of the anodes to prevent holes or depressions from forming in them, owing to the abstraction of the lead from these spots by adjoining parts of the anode which had cooled more rapidly. By regulating the rate of flow of the molten lead into the molds, and by pouring slowly, this was overcome. Each anode required approximately 200 lb. of pig lead. The supporting bar of copper, after being tinned, was cast in the anode.

The refining plant is housed in a steel building 135 ft. wide by 187 ft. long. It consists of one 150-ton refining furnace having a hearth dimension of 12x29 ft., with a brick bottom; a 40-ft. diameter casting wheel, a bosh conveyor, a 50-ft. inspection conveyor, and an electrically driven mold press. Over the casting wheel bay is a 5-ton, alternating current, overhead crane. In the bay on the charging side of the furnace is a 2½-ton cathode charging machine patterned after that in the Great Falls plant.

Preliminary Firing

As plenty of time was available for heating up the furnace, a light wood fire was kept burning therein for over two weeks, beginning in August, 1928. Thus it was dried out slowly and heated up very gradually. During the next ten days, the wood fire was increased slowly until the furnace was ready for the oil. To keep the fire off of the brick bottom of the furnace, it was carried on sheets of corrugated iron supported by rails. This was necessary to prevent the too rapid heating of the bottom at the spots where the fire would have been if it had rested directly on the brick. When ready for the oil, men entered the furnace, cleaned out the ashes and iron, and covered the bottom with half an inch of ground silica brick. The oil burners were then started, using the smallest amount of oil that they could handle. As the regular furnace burner would not burn with the small amount of oil that it is desirable to use in starting, to have had a specially small burner to use would have been desirable at this stage. The temperature in the furnace was gradually raised and the tapping hole closed with loosely laid brick to prevent the expansion of the side from closing it. The temperature was finally raised to the highest point permissible, the top tie rods being slackened off as required. At the bottom, 8-in. wooden washers were used on the ends of the tie rods, these blocks being crushed as the bottom of the furnace expanded.

As no refinery slag was available to put in the furnace at this time, the melting of which would seal the holes between the bricks, the furnace was then allowed to cool to a dark red, after which the wooden blocks were taken off and replaced with iron washers, and the tie rods tightened. The fire was then increased until the temperature in the furnace was raised to the melting point and a light charge of starting-sheet scrap was fed in by hand. Altogether, the oil was on ten days before charging.

Details of Furnace Charging

About 6,500 lb. of scrap comprised the initial charge, and as soon as it was melted, the copper was tapped out and the furnace was chilled. Of the 6,500 lb. charged, 2,600 lb. was tapped out. The temperature was then raised and the following day 37,600 lb. of copper was carefully charged to prevent injury to the new bottom. As soon as this charge was melted, it also was tapped out and 35,000 lb. recovered. The next charge was refined and merchantable wirebars were produced. A high-grade wirebar was made from the beginning, but as the crews became broken in, the results improved. The wirebars will average in per cent:

Copper	99.953	Antimony	0.0007
Sulphur	0.0018	Oxygen	0.038
Arsenic	0.0004		
Conductivity, annealed	101.2		

The amount of copper tied up in the furnace bottom naturally increased, and after a short time it amounted to 49 tons. An absorption of 75 tons had been allowed for the 150-ton furnace.

New Use Suggested for Wire Saw in the Slate Industry

THE WIRE SAW, a novel device introduced into this country by the U. S. Bureau of Mines, and described by Oliver Bowles in the March 24, 1928, issue of *Engineering and Mining Journal*, has revolutionized slate quarrying in Pennsylvania. The success of the wire saw, according to a recent announcement of the Bureau, has continued to increase as the equipment has been perfected and skill acquired in its use. In the first test made, a cutting rate of 9.7 sq.ft. per hour was attained; in the next four cuts, made early in 1927, the average rate of cutting was increased to 12.8 sq.ft. per hour; in 1928 a maximum of 34 sq.ft. per hour had been attained, with a general average of about 20 to 25 sq.ft. The wire saw is now regarded as essential equipment in practically all of the quarries in the Bangor, Pen Argyl, and Windgap districts.

It consists of a three-strand steel cable of $\frac{3}{16}$ or $\frac{1}{4}$ in. diameter running as an endless belt. The driving pulley is a 40-in. double-groove cast-iron sheave. A tension pulley supported by a frame mounted on wheels may travel back and forth on a short track. A weight of 800 to 2,000 lb. gives the desired tension on the wire. The driving units consist of electric motors with direct-drive compactly inclosed gear reduction, or double-belt speed-reduction units; the former are preferred. Silent chain and pinion gear reductions are used to a limited extent. Traveling speed of the wire is about 15 ft. per second.

The unqualified success of the wire saw in slate quarries suggests an extension of its use in slate-finishing mills. In mills where circular saws are now employed the blocks might be lined up in such a way that many of them could be cut at one time with a wire. Ten to 20 blocks are lined up and a wire is used to "scabble" or square them up by slabbing off the irregular surfaces. The equipment would be much simpler and less expensive than circular saws. The designing of such a mill has not yet been undertaken, but it offers a fruitful field for enterprising operators.

Has Arizona Important Undeveloped Copper Deposits?

WITH COPPER at present satisfactory prices, and a constantly increasing demand for this quality metal, the question of future supplies is important. Arizona now produces 40 per cent of the country's copper and almost 20 per cent of the world's production. Is all the development in the future going to be in Africa and Canada, or does Arizona contain reserves hitherto untapped? Mr. J. B. Tenney, geologist of the Arizona Bureau of Mines, will summarize the various copper districts of the state, producing and non-producing, in an early issue, his article being illustrated with a sketch map showing where the copper occurrences referred to are located in relation to rail transportation and smelter facilities.

Mine Subsidence Problems and Their Solution

A STUDY of subsidence and ground movement in the copper and iron mines of the upper peninsula of Michigan has been made by the U. S. Bureau of Mines.[1] As a result of subsidence, the country adjacent to the mines and overlying the mine workings in this district is often broken to such an extent as to affect its value; mine shafts and development openings are occasionally damaged so that they are useless, and water can enter the workings through fractures and cave-ins. The problem is more serious in the iron-mine districts, where villages and towns not owned by the operating companies have grown up around mining operations.

THE water problem is also more serious in the iron-mining localities, in that, by the methods of working used, the bedrock is definitely and purposely broken, permitting any water impounded in glacial drift to enter the mines. Large areas in both regions are overlain by deposits of sand and gravel from a few feet to 200 and 300 ft. in thickness, which usually carry water under corresponding heads. Aside from being the source of large quantities of water, the glacial drift may be a hazard to life and property through the sudden collapse of the supporting bedrock, accompanied by inrushes of sand and mud. Similar conditions exist in localities where the mine workings are adjacent to or extend beneath streams and other bodies of water.

The failure of hanging wall, top rock, and formations inclosing orebodies is caused by mine excavations in conjunction with lines of weakness in the rocks, such as bedding planes, joints or slips, and faults. The number and prominence of the slips give them a predominating influence in the control and direction of subsidence and ground movement.

Failure originates in stopes and extends to footwall and hanging-wall rocks; with slight cover, cave-ins occur; with considerably greater depth extensive fracturing of overlying rocks takes place with settlement; and with much greater depth, settlement or subsidence results, often with only slight fracturing. The movement to and into the mining excavations is designated as "draw" and follows certain well-defined lines, which vary with the locality, but are remarkably regular and uniform, even in disturbed areas. Buckling contributes materially to ground movement and may alone be responsible for extended disturbances.

WITH a knowledge of controlling and directing factors in ground movement the development of properties can be planned for maximum protection of workings and surface, but protection to both workings and surface after failure begins is difficult if not futile. However, by changes in the method of attack in mining, and by the use of filling, it is possible to reduce and sometimes to prevent serious damage.

After making a careful study of a large number of records of elevation taken during the period of subsidence over mined areas, as obtained from levels run across properties, it is evident that they are of little value in the interpretation of conditions underground relative to ground movement and subsidence. A careful study of the character, condition, and occurrence of ore and the associated rock formations, however, will yield information of much importance, which, supplemented by observation of the movement of rock masses, will usually give the key to the situation.

Mining operations, including all development work, such as shaft sinking, the driving of drifts and crosscuts, the erection of the mine plant, and the location of villages, can be safeguarded to the best advantage by making a careful study of conditions before the property is developed. It can be accomplished by determining the factors that control the failure of formations and placing the vulnerable parts of the proposed operations well outside the areas subject to damage by subsidence and ground movement.

By far the larger number of examples of damage to mines and adjacent property is connected with active workings and usually what may be classed as old operations. The work to be done has therefore passed largely from the precautionary to the remedial. The following remedial measures may wholly or in part prevent damage or its further extension: (1) Carry the working face or longer dimension of the workings parallel to or diagonal with the line of draw; (2) leave blocks of unmined ground to be removed during the last stages of mining, if possible; (3) use a filling of waste rock, particularly in connection with block mining; (4) fill caving pits with waste rock, thus increasing the support of the walls; and (5) release masses of the hanging walls and footwalls by blasting or otherwise loosening the rock, which would also serve to increase support of the walls.

WHEN it is possible to control the direction of the working face the draw in the wall rock will be greatly reduced by presenting the shortest line of least resistance to the movement, such as when the face of the workings parallels or cuts across the draw.

If left close enough together, blocks of unmined ground will effectively check ground movement; but it may be impossible to reclaim entirely the ore left in blocks for such purpose.

Waste filling is always effective in retarding the movement of wall rock into caving pits, but owing to the expense it is questionable whether it can be used to advantage; however, filling introduced into caving pits at the surface has an additional advantage, in ease and economy of placing, in that its added weight makes it more effective.

Shafts or buildings adjacent to caving pits may be protected by running waste rock into the pit and banking it against the wall at a point nearest the area needing protection. The supporting effect of the bank of waste may be sufficient to prevent collapse of the walls until the workings have attained considerable depth. Furthermore, large masses of rock detached from the walls in the workings would, by their usual increase in volume, hold back and often check, for certain periods, the draw of wall rock.

[1]Bureau of Mines Bulletin 295, "Subsidence and Ground Movement in the Copper and Iron Mines of the Upper Peninsula, Michigan," by Dr. W. R. Crane, copies of which may be obtained from the Superintendent of Documents, Washington, D. C., for 40c.

USEFUL OPERATING IDEAS

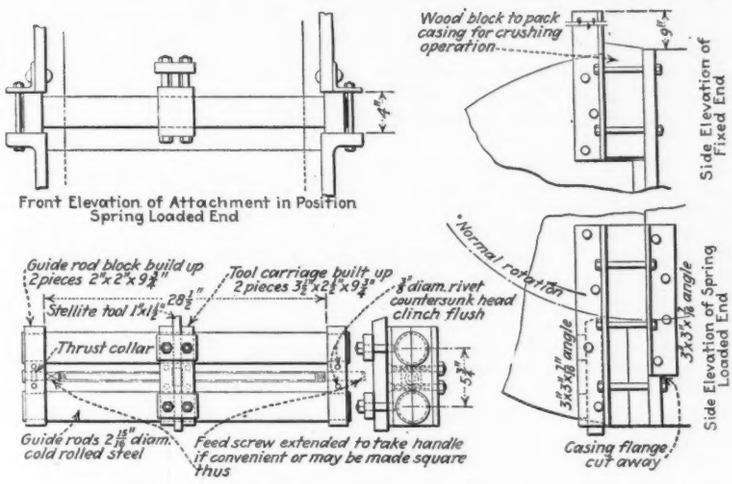

Front Elevation of Attachment in Position
Spring Loaded End
Wood block to pack casing for crushing operation
Side Elevation of Fixed End
Normal rotation
Guide rod block build up 2 pieces 2"x2"x9¾"
Tool carriage built up 2 pieces 3½"x2½"x9¾"
⅞" diam. rivet countersunk head clinch flush
Stellite tool 1"x1½"
Thrust collar
Guide rods 2 15/16" diam. cold rolled steel
Feed screw extended to take handle if convenient or may be made square thus
Casing flange cut away
Side Elevation of Spring Loaded End

Fig. 1—Details of roll-facing attachment used by Lake Shore Mines, Ltd.

Roll Shell Corrugations Removed by Grinding

CORRUGATIONS in roll shells are removed most commonly by mounting a cutting tool on the roll frame and turning them down, the rolls being run at reduced speed for this purpose. Fig. 1 shows the roll-facing attachment used on its Allis-Chalmers-Anaconda 54x24-in. rolls by the Lake Shore Mines, Ltd., Kirkland Lake, Ont. The cutting speed is 37 ft. per minute. This reduced speed is obtained by means of an auxiliary shaft and motor, as shown in Fig. 2. The shaft of the roll motor is extended and a gear, *B*, keyed on. This is driven from a small pinion on the countershaft, which is belt driven from a 10-hp. motor. When the refacing is completed and the rolls are to be restarted, pinion *A* is swung out of mesh and gear *B* is removed.

Time required for cutting is four and one-half to seven hours, a cut being necessary every 20,000 tons of ore crushed, approximately. The cut is made $\frac{1}{16}$ in. deep on the average, though it may be as much as $\frac{1}{16}$ in. Time required to cut off corners is one and one-half hours. For cutting, stellite tools have proved the best of those tried to date. Data presented have been supplied by E. B. Knapp, general superintendent.

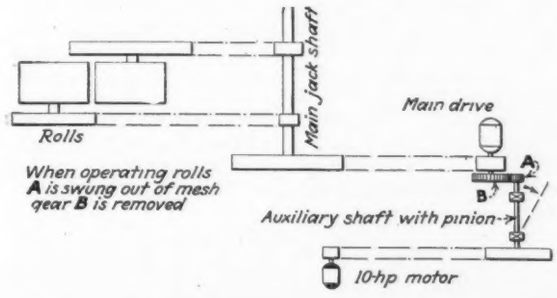
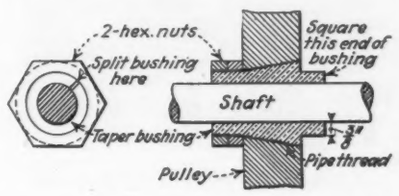


Fig. 2—Arrangement of auxiliary shaft and motor to permit rolls to be run at reduced speed for grinding

Taper Bushing Holds Pulley on Defective Shaft

SOMETIMES it is difficult to hold a pulley on the shaft with a setscrew so that it will run true with the face as well as the outside diameter. This may be done by making a taper bushing as illustrated, according to R. M. Thomas, of Denver.

The bushing should be bored out the size of the shaft on which it is to be used. It should be turned down on the outside large enough to allow a wall $\frac{3}{8}$ in. thick on each end. The center should be turned from the size of the straight thread fit on a taper of $\frac{3}{4}$ in. per foot to the large diameter of the opposite end. A thread should be cut in the bore of the pulley, which is also tapered. A straight thread is cut on one end of the bushing to fit two hexagon nuts. These lock the bushing after it is screwed in the pulley and tightened to the shaft. The other end of the bushing should be squared to allow a wrench to be applied to it, to tighten it on the shaft from that point. After the bushing is made, it should be split through one side.



Details of taper bushing for holding pulley on shaft

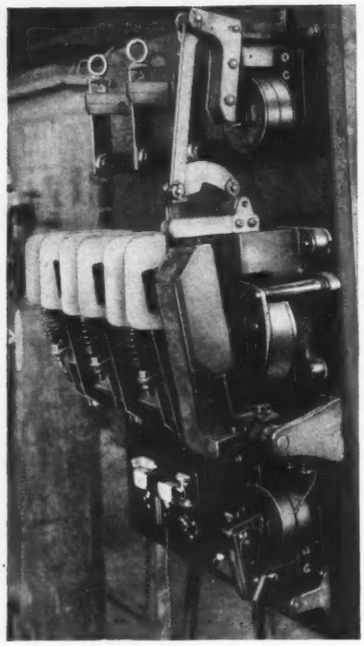
This is a safe method of tightening a pulley to the shaft, no setscrew is necessary, and the pulley can be held absolutely true at all times. The shaft is protected from damage should a setscrew come loose and cut it. This idea can be applied to any size of pulley and shaft, provided the sizes are in proportion. The bushing described was made for a 1½-in. shaft.

The pulley should be placed on the shaft so that the belt pull will tighten it on the bushing and shaft. This can be accomplished by having the pressure of the belt tighten the threads by pulling to the right if right-hand threads are used, and to the left if left-hand threads are used. The lock nuts will hold the bushing in place.

Inserting Tight-Fitting Tubing Into Stoppers

DIFFICULTY having been experienced in inserting glass tubing into holes in rubber stoppers where a tight fit was essential, the following scheme was hit upon, says T. J. Cochrane in a recent issue of *The Chemist-Analyst:*

After boring the hole to the desired size, the cork borer of the next size larger is forced through the hole already made. The glass tubing is now inserted into the cork borer within the stopper to the desired position, and the cork borer withdrawn, leaving the glass tubing in the position desired. This makes a safe and easy way to insert glass tubing into holes in rubber stoppers, and prevents to a large measure all the risks attending the inserting of glass tubing into rubber stoppers by the use of physical force.



A 100-hp. contactor developed and built by Utah Copper

Novel Contactors Developed by Utah Copper

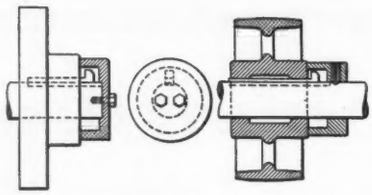
THE Utah Copper Company has developed and built its own contactors. These come in two sizes, 100 and 200 hp. The 100-hp. size serves 75-, 150-, and 200-hp. motors. All of these contactors have been found to be foolproof, economical, and efficient. In construction, they consist of a solid cast-iron operating magnet with a small holding coil attached. A push-button energizes the operating coil of the contactor, which closes the contactor and energizes the holding coil, which in turn locks the contactor in closed position. As soon as the starting button releases the power from the main operating coil, the current is shut off, so that the only power used is that consumed in the small holding coil. The result is, it is asserted, that this contactor uses less watts than any other contactor of the same size.

Safety Guards for Exposed Keys

ABOUT a year ago our company put on a "safety-first" campaign with a view to reducing the accidents around the power and manufacturing plants, and the decrease in accidents since that time has proved the move to be well worth while, writes C. A. Leonard in *Power*.

The campaign consisted essentially of putting guards around flywheels, belts, and any exposed rotating member, and the method we used to cover projecting keys, of which there were many, is shown in the illustration.

Three types of covers were used, two of which are illustrated. Where the



Sketch showing how the shaft keys are covered

cover could be placed over the end of shaft, as in the left-hand illustration, it was recessed slightly to center on the shaft and was held in place by two capscrews. One screw is sufficient to hold the cover, but it necessitates destroying the center in the end of the shaft.

The other type shown was used where the shaft extended on both sides of a coupling or pulley. It so happened that just at that time we were making extensive alterations to our manufacturing plant, so in reassembling the drives the covers were slipped over the shafting before the pulley and couplings were put on.

In cases where the drives were not touched, a similar cover made in halves was used; it was clamped to the shaft by two capscrews inserted in recesses so that the heads came below the surface of the guard. A close-fitting lock washer was used below the heads of the capscrews.

These guards have been in use for about a year now, and not one has loosened on the shaft, and as a safety device they have proved entirely satisfactory.

Clearing Plugged Transfers

A PLUGGED transfer raise often causes considerable delay and expense before it is opened again to the free flow of broken rock. Ordinary methods of freeing the raise, such as running water down it, driving a pipe into the mass from above and loading the pipe with dynamite, or raising a bundle of dynamite tied to a long pole, do not always succeed. Sometimes it is thought necessary for a man to climb up under the suspended mass and place a charge of explosive against the jam. This is a very dangerous practice and should never be allowed.

At the United Verde Copper mine, Jerome, Ariz., according to W. P. Goss, chief efficiency engineer, it has been found feasible to open many plugged raises by drilling into the jam with a deep-hole prospecting drill, and then blasting. We have, says Mr. Goss, two sets of Denver Rock Drill Manufacturing Company's deep-hole prospecting equipment, which consists of Waugh Model 34 drifters, threaded sectional drill steel and couplings for use in sampling and in prospecting operations.

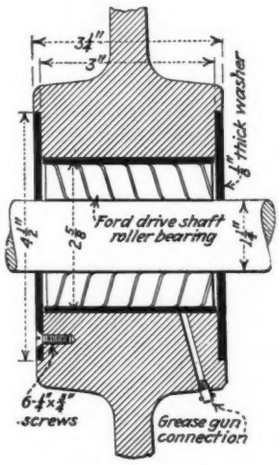
When the jam in a raise occurs at such a point that it cannot be reached by a drive pipe from above or long poles from below, the deep-hole drill is used. The direction and inclination of a hole from the nearest available opening to the estimated position of the jam are calculated in the engineering office, and a surveyor lines up the machine underground to drill such a hole. The broken rock in the raise is penetrated a foot or two, if possible, and the hole is then shot with three or four sticks of 50 per cent gelatin dynamite.

If it is found impossible to maintain a hole in the broken rock within the raise, dynamite tamped tightly in the end of the hole against the broken rock will generally jar the jam loose when exploded.

Roller Bearings Improve a Sheave Wheel

By Charles Labbe

SHEAVES placed in an inclined shaft to support the weight of the cable sometimes stick, and, as a result, the cable sometimes wears through the sheave by rubbing. At one property



Sheave hub equipped with Ford drive shaft roller bearing

sheaves were fitted with bronze bushings, and grease cups were balanced, and were properly installed. Experience proved, however, that some of the fines would work between the shaft and hub and cause trouble.

When one of these sheaves had to be changed the original installation was improved as follows:

The hub of the sheave was bored out to 2⅝ in. to accommodate a Ford drive-shaft roller bearing. A shaft was made of a piece of 1¼-in. cold-rolled shafting. The sides of the hub were turned down so as to hold a sheet-iron washer on each side, the washer being held by six ¼-in. flat-head screws, as shown in the accompanying sketch.

The new design proved satisfactory. Since then all of the sheaves have been replaced, and none has been found to be inoperative, nor have any worn unevenly.

The application of grease has been found to be necessary only twice a month.

INDUSTRIAL PROGRESS

Lake Shore Mines Finds Dust Removal Advantageous in Crushing

PROGRESSIVE management is evident in the operations of Lake Shore Mines, Ltd., Kirkland Lake, Ont., in many ways. One of these is in its use of dust-collecting and removal equipment in its crushing plant, something that a small percentage of North American mills are doing, despite the better operating conditions it creates.

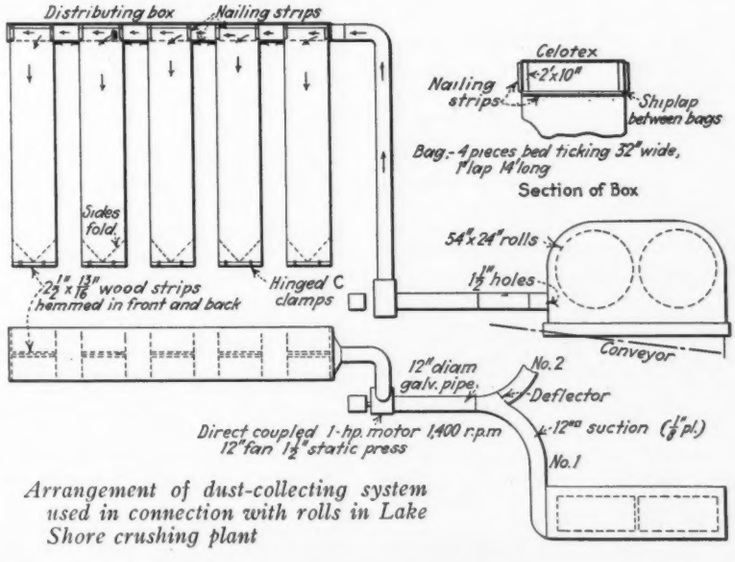
The system, which was designed chiefly by D. L. Cramp, master mechanic, according to the superintendent, E. B. Knapp, consists of two units, one for the two sets of 54x24-in. rolls and one for the two 5½-ft. Symons crushers. In each case the object is to draw the dust from the hoppers below the machines and thus prevent it from becoming diffused in the air. For this purpose a 12-in. direct-connected fan is used, driven by a 1-h.p. motor and having about 1½-in. static pressure at the discharge. The dust is conducted to a box from which are suspended large bags made of bed ticking and having a total area of about 700 sq.ft., the air being filtered through the bags and the dust falling to the bottom, where it is drawn off each day by opening the entire lower end of the bag. The arrangement is indicated in the accompanying sketch. To shake the dust from the inner surface and thus increase the filtering capacity, the bag is tapped with a strip of wood.

From one set of rolls reducing 1,300 tons per day, about 400 lb. of fine dust is obtained, or just over 30 lb. per hundred tons of ore crushed. From the Symons crusher, which is in series with the rolls, about 100 lb. is gathered, this making the total approximately 500 lb. of fine dust from 1,300 tons of ore. This varies with the moisture in the air.

The system has proved effective, according to Mr. Knapp, eliminating the suspended dust almost entirely. The labor required each 24 hours is limited to that needed for drawing off the dust from the bags, and, as the discharge ends of the bags are easily accessible, twenty minutes easily suffices for this work, during which the fan is temporarily closed down.

Up to the present the equipment has functioned satisfactorily. For a plant of this size the company is well pleased with the installation. Mr. Knapp says that he knows of no system more effective, taking into account first cost, maintenance, efficiency, power consumption, and the fact that the dust collecting process, being dry, can be operated when temperatures are below freezing.

The length of life of the bags is not definitely known, but it is believed to be about one year. Each of the installations would cost approximately $400.



Arrangement of dust-collecting system used in connection with rolls in Lake Shore crushing plant

The Equipment Review

THE modified design of the shovel described in the following, the stoneware-lined pump, the new type of d.-c. cam switch, and the hand-power core drill will undoubtedly interest many operators, especially those whose working conditions will permit their use.

A Shovel for Cramped Quarters

To provide the proper clearances required for work in certain cramped conditions, the design of two electric Lorain 75-A shovels was recently modified by the Thew Shovel Company, Lorain, Ohio, for the Cleveland Railway Company. To provide the desired clearances, the shovels have been "bobtailed," the standard tailswing of 10 ft. having been reduced to 8 ft. 9½ in. To reduce the clearance further, the left rear corner of the cab and rotating platform has been cut off diagonally, thus permitting the shovel to swing farther without fouling the adjacent track. Just as these modifications have been made to suit the needs of a railway company, others can be made in the design of this shovel to adapt it to particular conditions in tunneling or other underground work. These changes in no way affect the crawler or superstructure. The shovel furnished the Cleveland company is equipped with a 50-h.p. a.-c. or d.-c. motor, which may be had in a range of types suitable for any practical current. The motor is automatically controlled by push button.

A Corrosion Resisting Pump

A line of centrifugal pumps, lined with chemical stoneware and of efficiencies comparable to those of all-metal pumps, has recently been introduced by the U. S. Stoneware Company, 50 Church St., New York. The design is along correct hydraulic lines and embodies all modern improvements, it is said. By reason of the acid-proof coating on the casing, impeller, and all parts that come in contact with the liquid handled, the pumps are incorrodible. The manufacturer recommends them for handling all corrosive solutions, including acid mine waters, weak or strong, with the exception of hydrofluoric acid. The impellers are non-clogging and have the fluid passages arranged to handle solids in suspension. Cast integral with the impeller where the shaft goes through is a metal bushing which is machine-threaded. The impeller is mounted directly over the steel shaft,

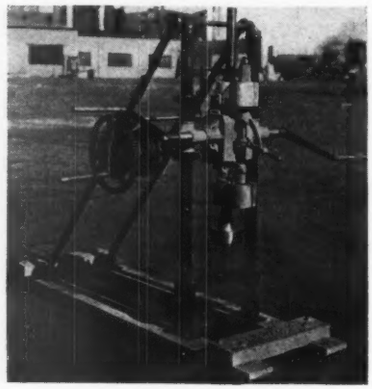
thus eliminating the possibility of breaking it, as commonly happens with older types of stoneware-lined pumps. The bushing is fully protected against contact with the fluid handled. This is effected by the shaft sleeve and stoneware nut, which is threaded on the outer end of the shaft. A patent is pending on this feature. Complete ball-bearing equipment is provided, as well as pressure grease connections. The pumps are made in two standard sizes, one of a rated capacity of 225 g.p.m. and the other with a capacity of 500 g.p.m.

New Cam Switch for Controlling Auxiliaries

General Electric has announced a new direct-current cam switch (CR-3108), developed to meet the needs of power plants for a device of this type to control auxiliaries such as pumps and blowers. The switch can also be used for similar non-reversing applications where the current inrush or starting torque is not severe or the operations are infrequent. Two forms are available. Both are for non-reversing service with armature regulation over five points. One has field regulation over 22 points. The intermittent armature current capacity is 1,000 amp., and the same capacity at continuous rating is 500 amp. The switches are rated at a maximum of 550 volts.

Core Drilling by Hand

In the illustration presented herewith is shown a hand-powered core drill, using chilled steel shot as a cutting medium. It is made by Sprague & Henwood, Inc., 221 West Olive St., Scranton, Pa., who have recently received an order for fifty from the Chinese government. The drills are light enough to be taken apart and transported by canoe, or on mule-back or by airplane, to isolated districts where hand-power is the only kind available.



A hand-power core drill using chilled shot for cutting

Electric Welding With Atomic Hydrogen Has Gas Welding Characteristics

THE APPARATUS used in atomic hydrogen welding is simple, consisting of two tungsten electrodes and an electric arc, established between them, and everything is shielded by a frame of hydrogen. The torch used for welding is simplicity itself—support to hold the electrodes, and two tubes directing a hydrogen flame around the electrodes, this according to Peter P. Alexander, of the General Electric Company's Thomson Research Laboratory, at the Industrial Heating Conference held at Massachusetts Institute of Technology on Feb. 28. All energy supplied to the weld is from an electrical circuit. The gas serves only to shield electrodes, protect the metal from oxidization, and increase arc efficiency.

If the arc of the same current and length be maintained in an atmosphere of nitrogen, the potential drop along the arc core will be about ten volts per centimeter. When nitrogen is replaced by hydrogen, the potential drop will be increased fifteen times, so that by blowing hydrogen toward this arc, the efficiency is increased. In this way it was possible, for the first time, to use the indirect arc in an efficient way.

Several processes involving the use of the indirect arc for welding exist but are inefficient. Only when air was replaced by hydrogen was the efficiency of the process of indirect arc welding increased to such a degree that it is now a successful process.

All the energy is coming from the electrical circuit, so it is essentially an electrical process of welding, and yet it possesses all the characteristics of a gas-welding process. This process is adaptable to welding thin materials.

Another field of its application is welding of special alloys and low-melting-point alloys. The use of special alloys is increasing every day.

Since in the atomic hydrogen process the electrodes are non-consuming, the material may be added to the welded plate from a special welding rod, of any desired composition. If an attempt to do so with direct arc is made, the operator will find that if the electrode has high chromium or carbon, an arc can hardly be maintained. However, if the arc is maintained independently, this rod can be used quite easily.

The importance of aluminum and other light alloys is increasing. These alloys can scarcely be welded with the direct electric arc. However, they can be welded with gas. On account of the low melting point of these alloys when an arc is established between the electrode and the plate, much of the metal is vaporized, but with the indirect arc the temperature may be easily kept within the desired limits.

Hydrogen protects the alloys from oxidation. The greatest obstacle for welding aluminum is the formation of aluminum oxide, which prevents the metal from running together. With atomic hydrogen welding, aluminum can be welded under certain conditions without this danger of formation of aluminum oxide, and the aluminum oxide already formed can even be reduced to its metallic state. Still, it is not practicable at present to use the atomic hydrogen welding process for welding thin aluminum sheets without fluxes, on account of the desire to maintain a high speed in welding the thin materials. So in practical applications of the torch for welding thin aluminum sheets, additional fluxes are used.

Cylinder Lubrication Important in Compressor Operation

IN AIR compressor operation, cylinder lubrication, although of great importance, seems little understood, according to *Oil Power*, the monthly bulletin of the Standard Oil Company of New York. To appreciate the necessity of proper air cylinder lubrication, a consideration of conditions commonly met is essential.

Carbon deposit quite often is caused by a lubricant that is not of the proper qualifications and that is easily broken down by the heat of compression. It may also be caused or increased by the use of too much oil. Deposits on cylinders may be formed through improper screening of the suction end of the compressor, thus permitting dust to enter the air cylinder and add to the accumulation of carbon already being formed. Usually, carbon collects on pistons and cylinder heads and so causes obstruction at the ports and leakage at the valves. This makes the air compressor work just so much harder to supply the same amount of air.

In selecting oil for cylinder lubrication, it is essential to consider air pressure and the temperature of the discharge, because as the pressure increases the temperature of the air rises. Air at 60 deg. F. compressed to 10 lb. per square inch has a temperature of 145 deg. F. At 20 lb. per square inch, it reaches 207 deg. F. Use of a lubricant that is higher in flash point than the temperature of the air discharge is therefore necessary to prevent carbonization.

In a compressor of two stages or more, the operating conditions are not so severe as in a single-stage unit. This may be explained as follows:

When air is compressed in a single-stage compressor from atmospheric pressure at a temperature of 60 deg. F. to 100 lb. per square inch, the maximum temperature will be 485 deg. F. If this same volume of air were compressed in a low-pressure cylinder, or if the first stage compression reached 25-lb. pressure, the temperature would be 235 deg. F.

The air passing through the intercooler would be brought back to the

original temperature of 60 deg. F., and then compressed in the second stage cylinder or, high side, from 25 lb. to 100 lb. pressure. Maximum temperature would be little, if any, in excess of that in the first stage cylinder, because the heat of compression depends upon the ratio of compression and is independent of the initial pressure. Therefore it can readily be seen that simpler lubrication problems are met in compressors of two or more stages than in a single-stage machine.

The quantity of lubricating oil to be used in an air cylinder depends upon the viscosity of the oil and the size of the cylinder. When the surface of the cylinder walls is once lubricated with a film of oil, a small amount of the oil is thereafter required.

In some instances, particularly on marine Diesel engines, the intake air is likely to be moist. Use of a compounded compressor oil is therefore necessary. This condition is rarely found on a stationary compressor, except where the plant is situated on a water front where the high relative humidity would make the intake air moist.

INDUSTRIAL NOTES

The Thew Shovel Company and the Universal Crane Company announce the removal of their New York sales offices to the Chanin Building, New York City.

Dayton-Dowd Company announces the appointment of the Corken Pump & Machinery Company, of Oklahoma City and Tulsa, as its Oklahoma district representatives.

The Roller-Smith Company announces the appointment of Jackson Brown, Jr., 701 Kittridge Building, Denver, Colo., as its district sales agent for Colorado, Utah, Wyoming, and New Mexico.

Raymond M. Sievers has been appointed district sales manager of Harbison-Walker Refractories Company, with headquarters in St. Louis. His territory extends from the Mississippi River to the Rocky Mountain states.

A branch office of the Philadelphia Gear Works was opened in the Farmers Bank Building, at Pittsburgh, Pa., on May 1.

The Johns-Manville Corporation has announced the acquisition of the United States and Canadian rights to manufacture and sell "transite pipe," a seamless pipe made of asbestos and cement, under the patents of the Eternit Peitra Artificiale, Societe Anonima, of Genoa, Italy.

A sales office has been established in Cleveland by the Manganese Steel Forge Company, manufacturers of Rol-Man rolled and forged manganese steel products, Philadelphia, Pa. The new office is at 623 Union Trust Building, Cleveland.

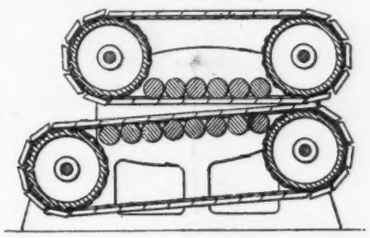
The General Refractories Company has appointed Woodward & MacMillan, Edificio Metropolitano, Havana, Cuba, as sales agent for Cuba and Central America.

PATENTS

PULSATING JIG. No. 17,272, reissue. April 16, 1929. M. J. Lide, Birmingham, Ala.
A hydraulic jigging machanism.

AMALGAMATOR. No. 1,708,970. April 16, 1929. D. H. Kleinschmidt, Los Angeles, Calif.
A rotating bowl amalgamator.

CRUSHING AND GRINDING MACHINE. No. 1,706,290. March 19, 1929. A. C. Hamey and J. Stoneham, Sydney, Australia.



An improved crushing and grinding machine of the internal vertical feed-tube type.

CLASSIFICATION BY ELUTRIATION. No. 1,705,351. March 12, 1929. L. Andrews, Westminster, England.
A method and apparatus for classifying material by elutriation.

CONCENTRATOR. No. 1,706,552. March 26, 1929. A. H. Stebbins, Los Angeles, Calif.
Design for a concentrator of the table type.

CONCRETE ORE-BUNKER PLANT. No. 1,707,898. April 2, 1929. J. Bock, Dortmund, Germany.
A concrete ore-bunker plant insuring a continuous discharge of ore from the bins.

CHARGING APPARATUS. No. 1,707,937. April 2, 1929. J. E. Gerlach, Duisburg, Germany.
An apparatus for charging tilting smelting furnaces, intended particularly for electric furnaces.

SKIP HOIST. No. 1,707,954. April 2, 1929. R. H. Beaumont, assignor to R. H. Beaumont Company, Philadelphia, Pa.
Design for an incline skip hoist.

SKIP HOIST. No. 1,707,958. April 2, 1929. A. Warner, assignor to R. H. Beaumont Company, Philadelphia, Pa.
An improvement for skip hoists, consisting of an equalizing sheave attached to the counterweight.

HOISTING MECHANISM. No. 1,708,188. April 9, 1929. C. F. Osgood, assignor to Sullivan Machinery Company, Chicago, Ill.
Design for a hoisting mechanism.

LIQUID ZINC. No. 1,708,403. April 9, 1929. F. Tharaldsen, Oslo, Norway.
A rotary drum to be used in making liquid zinc from blue powder.

ROCK CRUSHER. No. 1,708,562. April 9, 1929. A. W. Barton, E. Du Lac, and E. M. Ferguson, Minneapolis, Minn.
A jaw-type crusher.

WHEEL MOUNTING. No. 1,708,608. April 9, 1929. G. E. Edmunds, assignor to The Bonney-Floyd Company, Columbus, Ohio.
A wheel mounting for mine cars.

HOISTING MECHANISM. No. 1,708,677. April 9, 1929. L. A. Maxson, assignor to Sullivan Machinery Company, Chicago, Ill.
Design for a hoisting mechanism.

SKIP HOIST. No. 1,708,913. April 9, 1929. R. H. Beaumont, assignor to R. H. Beaumont Company, Philadelphia, Pa.
Design for a skip-hoist structure.

TABLE CONCENTRATOR. No. 1,704,265. March 5, 1929. J. Stephan, Chico, Calif.
Design for a concentrator of the table type.

FLOTATION REAGENT. No. 1,709,447. April 16, 1929. B. R. Tunison, Elizabeth, N. J.
Production of an oily flotation reagent by washing a sulphurous petroleum oil with an alkali solution.

GEOPHYSICAL PROSPECTING. No. 17,242. Reissue. March 19, 1929. B. McCollum, assignor to McCollum Geological Explorations, Inc., a Delaware corporation.
A system for determining the contour of a subterranean stratum and comprising a source of sound, sound detectors, and a sound measuring device.

OXIDIZED ORES. No. 1,709,329. April 16, 1929. J. T. Terry, assignor to C. E. Terry, Alhambra, Calif.
A concentration process for treating oxidized ores containing lead, zinc, silver, mercury, and bismuth, either singly or in combination. Finely ground ore pulp is treated with a chromate solution which leads to the formation of corresponding metal chromium derivatives. The metal that is affected by the chromium treatment is then concentrated by the flotation process.

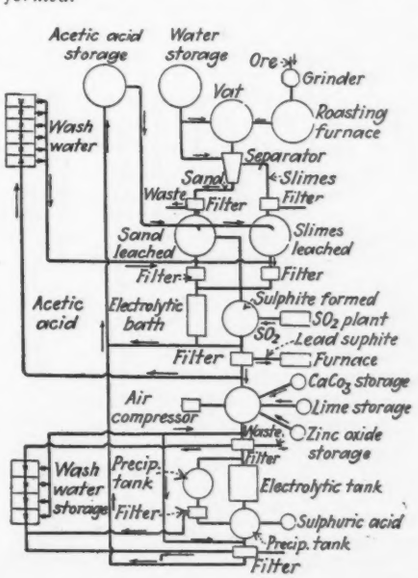
Rock Drills

No. 1,707,631. April 2, 1929. E. G. Gartin, assignor to Sullivan Machinery Company, Chicago, Ill.
Design for a cylinder member.

No. 1,707,649. April 2, 1929. R. S. Weiner, assignor to Sullivan Machinery Company, Chicago, Ill.
Design for drilling motor and means for locking feeding mechanism.

No. 1,707,882. April 2, 1929. J. M. Siebert and G. L. Warren, Johannesburg, Transvaal, South Africa.
Design for a rock drill.

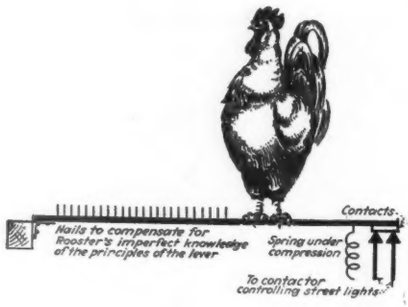
HYDROMETALLURGICAL TREATMENT OF LEAD AND ZINC ORES. No. 1,706,143. March 19, 1929. W. H. Corbould, Sydney, Australia.
A leaching process for the treatment of lead and zinc oxide ores. Sands and slimes are separately leached in an acetic acid solution, the oxides of lead and zinc are dissolved and acetates of these metals are formed.



BY THE WAY

A Suggestion to One-Shift Mining Companies

IN ITS READINESS to adopt ideas that have been proved successful in other fields, the mining industry ranks second to none. For this reason we have no hesitation in taking a leaf from the April 20 issue of *Electrical World*, which contains a suggestion that should prove valuable to mining companies operating on a one-shift basis or in spots where the climate renders manual work of any sort odious. In a little North Carolina town, writes L. H. Hardin, there is a superintendent of public works whose duties cover the operation, unaided, of the electric light system, the water works, the volunteer fire department, meter reading, and sundry other duties of a similar nature. Naturally, the fortunate incumbent of this position has little spare time. He is now obtaining material assistance, however, from a hefty rooster whose belief in the "early to bed and early to rise" habit is unshakable. Chanticleer's talents are utilized in the street-lighting department in a manner that evokes admiration. A special perch has been provided for him, pivoted at one end and so arranged that his weight will bend the perch and close the street-lighting circuit regularly at dusk and open it when he leaves his perch at


Contacts
Nails to compensate for Rooster's imperfect knowledge of the principles of the lever
Spring under compression
To contactor controlling street lights

Labor saving device extensively used in North Carolina

break of day. No device on the market today is quite as capable of taking cognizance of the early dusk on a rainy day or late darkness on a clear day or of the variable hours of dawn with the changing weather as is this old rooster, according to unbiassed persons who have had the privilege of witnessing the system in operation.

How Mines Are Discovered

CLOSE observation of rock exposures undoubtedly has been responsible for the discoveries of many mines. One of the most unusual recent instances concerns the Monarch mine near Field, British Columbia. During the summer of 1880, according to a Toronto paper, a prospector wandered into Kicking Horse Valley and discovered some rich float at the base of a 1,000-ft. cliff. By scanning the cliff with field glasses he discovered a spot that looked like an outcrop, and by means of rifle shots he succeeded in bringing down splinters of the exposed ore, which proved to be galena. Later, in scaling the cliff, he confirmed his discovery, but he could not make a descent from the cliff, and was rescued after being marooned upon the cliff for two days. Only recently the property was acquired by large mining companies. The story may or may not be based on fact, but it is a good one and portrays the resourcefulness of the prospector as well as his pertinacity.

Another story that appeared in the Provo *Herald* (Utah) is told by N. C. Hicks about the Relief mine. According to this, back in the early 'eighties John H. Koyle dreamed that a certain mountain, over which he had traveled many times when a young man, was impregnated with rich ores. So vivid was the dream that he made plans to find the hidden treasure, and then worked for years until recently, when samples, otherwise unpromising, in the hands of a certain assayer were reported to have a high platinum content. The platinum part of the story has not been confirmed so far. However, the interesting point is the dream.

The two stories illustrate extremes, one exemplifying the practical, the other the visionary. A new crop of stories will arise out of geophysical prospecting which will thrill and amuse mining readers half a century hence.

New York *Times* Still Uncertain About Hoover's Book

"A COPY of a first edition of 'Georgius Agricola De Re Metallica,' translated by President and Mrs. Hoover from the first Latin edition of 1556, brought $170 last night at the American Art Galleries. The buyer was H. F. Marks, New York book dealer.

"This volume, which was published in London in 1912, has come into considerable demand within the last year. Twelve months ago, according to book dealers here, the book sold for around $25. The price began to climb after the nomination of President Hoover at the Republican convention and since his inauguration has gone still higher.

"Its present price is much higher than that of a first edition of the original Latin work from which it is translated." —*The New York Times.*

About seven months ago, during the heat of the Presidential campaign, we had to pause in our editorial labors to take the New York *Times* to task for calling Hoover's translation of Agricola a classic work on agriculture. On April 20 the item reprinted above caught our eye, and although it is something of an improvement, nevertheless it is irritating to find that our efforts have not yet been entirely successful. How, we should like to know, would the *Times* feel if ten centuries from today someone should speak of a translation of "Adolph Ochs The New York Times?"

The Lillies of Utah, and Others

SHAKESPEARE has said "The evil that men do lives after them; the good is oft interred with their bones." That this quotation states a common truth is well recognized by those who have searched mining records. And particularly would it seem to apply as regards the confusion resulting from the spelling of the second word in the names of the Eureka Lilly and North Lily mines, adjoining properties in the East Tintic district of Utah.

Many persons on reading the word "Lilly" have undoubtedly smiled at what they have presumed was an error on the part of some writer, but to spell Eureka Lilly with one "l" would be as incorrect as writing the surname of President Hoover with one "o." Mining records reveal that the original locator of the Eureka Lilly, now part of the Chief Consolidated holdings, was a pioneer in spelling as well as in mining. Arriving from Provo, Utah, during the year 1869 in the little-known and practically unstaked Tintic district, Thomas Barrett located the "Lilly of the West" claim. It was so recorded, and, in order to keep all titles clear, this spelling has been perpetuated by the Chief Consolidated Mining Company.

A similar example is that of the Bellorphan claim of the Yankee Mines Company, situated in the American Fork district south of Salt Lake City. The pioneer locator of this property was, perhaps, inspired by the feats of the mythological hero, Bellerophon, or by the knowledge that Admiral Nelson's flagship bore the same title. Or, it may have been that he found *Bellerophon* fossils in the formation and named his claim after that geological term. But whatever the reason for his action, he erred grievously as to spelling and added to posterity's vexations by his aberration.

Recently the question arose as to how to spell the name of General P. E. Connor, often referred to as the "Father of Utah Mining," because through his initiative mining as an industry was first started in the state. Some writers substituted an "e" in the last syllable for an "o," making the name "Conner." Justification for this spelling was found in the first mining notice ever posted in Utah—that posted Sept. 17, 1863, on the Jordan claim at Bingham. On the faded and stained document, the name was signed "Conner." But George B. Oglivie, the original locator, was evidently more concerned about having his commander benefit by his discovery than about correct spelling.

COMMENT AND CRITICISM

Hardships of the Soviet Mining and Metallurgical Industries

To the Editor of "E.&M.J.":

In the issue of *Engineering and Mining Journal* of June 23, 1928, appeared an article by Theodore Dreiser, reprinted from the Washington *Evening Star,* about mining conditions in Russia, which he pictured rather optimistically. During my recent visit at Stanford University, I took the opportunity offered by the Hoover War Library and spent some time compiling data from the official Soviet publications on conditions in the mining and metallurgical industries, summarized below. All data are from *The Economic Life* for 1928, and *The Mining Journal,* for 1927, published in Moscow.

The mining and metallurgical industries in Russia reached their peak just before the war, in 1913-1914. The World War stopped the progress and dealt the first blow when the workers were mobilized for the army. During the years of the World War and the subsequent civil war, production continually decreased. Unfortunately, during the civil war the chief fronts were in the main centers of the mining industry, as in the Donetz Basin, the Urals, and the Kuznetz Basin. Destruction of transportation facilities during the civil war also had a bad effect on the metal production. The last blow was dealt to the industry when the Bolshevist government nationalized the mines. The result of the nationalization was that many mines were closed and others were left without management. In 1921 the bottom was reached by the industry, and only with the introduction of the "NEP" (New Economic Policy), when trusts were formed, did the mining industry begin to revive, at the beginning of 1923. Since 1923 rehabilitation has progressed rapidly, and in some instances pre-war marks have been reached. For example, the coal output in the year 1926-27 was 97 per cent of that of 1913-14.

During its rehabilitation, the mining industry met many obstacles, which retarded its progress and which should be removed if the leaders of the industry want to restore normal conditions. Some of the obstacles are: (a) multiplicity of planning agencies to which the mining industry is subjected, causing mismanagement and absence of co-ordination; (b) scarcity of technical men; (c) labor problems; and (d) the growth of the number of mine accidents.

The abundance of commissions and projecting agencies, which do their work without co-ordination, retard progress and increase the cost of production. As an example, the Embaneft trust (Emba oil trust) was obliged to stop the production of lubricating oil because it could not obtain 20,000 puds (one pud is 36 lb.) of cottonseed oil required for making it. The problem of obtaining this oil was brought to the attention of the Glavchim (Chief Chemical Trust), Glavhlopcom (Chief Cotton Trust), Maslojirsindicat (Butter and Grease Syndicate) and to other high institutions, but the Emba trust was left without oil and some factories had no lubricants. The inability to obtain cottonseed oil was not attributable to the absence of it, but to mismanagement. Another example of mismanagement: A factory in Moscow Province ordered five cars of special molding sand from the Urals. When it came it was found that it was not any better than the local sand, and it was thrown away. Sixty thousand connecting rods were ordered abroad for the same factory, but when they were received they did not fit the machines, so they were discarded. Many other such instances could be cited, which could be avoided with competent management and co-ordination.

At the Congress of the Gold Industry, where miners from all parts of Russia were represented, one of the speakers stressed the fact that one of the weakest points of the industry is scarcity of technically trained men. One of the districts, which covers 2,000 square kilometers in the Altai and is composed of twenty mining camps, has only one man who has had a technical education. The others are "practical miners." One of the reasons of such scarcity is the very low pay for engineers.

The labor problem in the mining industry in Russia may be divided into two parts: (a) large labor turnover and (b) loss of working days by laborers for unimportant reasons. The question of the labor turnover is one of the main obstacles to general rationalization of the industry. As yet it has not been investigated fully, but its influence can be roughly estimated. Returns show that in the Donetz coal basin the number of workers changed about three times a year. In the metallurgical industry the labor turnover is a sore spot also. In sixteen big metallurgical districts employing 112,000 men, during ten months 41,000 men were hired and 36,000 men were discharged. The large labor turnover increases the costs of production and decreases the labor efficiency. The explanation of the large labor turnover lies in the poor living conditions of workers. In a metallurgical plant which employs 14,000 men, only 1,211 have quarters provided by the plant; the rest are obliged to live in surrounding villages. The floor space per man in the Ural district has decreased from 3.7 to 3.2 square meters per man. In the gold industry, in addition to the absence of living quarters, there are no medical staffs or schools. This has an influence on the change of labor. There are some gold-mining camps where for one man there is only 1.25 square meters of floor space. In Eastern Siberia out of thirty mining camps only five have hospitals. Most of the mining camps have no schools; hence the children of workers have no educational opportunities. In all of the mining camps in Siberia, in the Urals, in Kasakstan, and other regions, there are only eighteen clubs, fifteen grade schools, and two high schools, and very few libraries. Absence of such conveniences causes the workers to move from one place to another in hope of finding better living conditions.

Another reason for labor migration is the difference in the wage scale for the same kind of work in different places.

Voluntary lay-offs by the laborers for unimportant reasons constitute a no less serious problem for the industry than that of the labor turnover. Its importance is especially noticeable whenever there is a campaign for lowering the costs of production.

From the normal length of the working year in Soviet Russia, what can be expected? According to the laws a worker is entitled each year to 18 days' vacation, 64 days of rest (holidays), and 12 days lost for sickness or for important reasons. The total number of legally lost days is 94, leaving 271 available working days per year. The 271 days in a working year should be the goal for the mining industry, and if it is reached it will differ only slightly from that in the Ruhr district of Germany.

The number of accidents in the mining industry of Russia is also large and tending to increase in many districts where safety departments are either

lacking entirely or are very inefficient. The necessity of improvement is realized and during the period 1923-27, the sum of 5,600,000 rubles ($2,800,000) was spent for the improvement of safety conditions in the mines.

The results of safety measures, where carried out, are noticeable. There the number of accidents is decreasing, but it still is very high when compared to the number of accidents in 1913. Some of the Soviet writers attribute the difference to: (a) better system for the recording of accidents now, compared with pre-war days; (b) decrease of efficiency per man; (c) increasing number of peasant workers who never before worked in mines; and (d) increase in the use of machinery without properly qualifying workers.

Considering the foregoing analysis it is possible to say that the mining and metallurgical industries are confronted with problems which must be solved before these industries can develop normally. It is essential to establish a commission under which all governing bodies having similar purposes are grouped, and to put competent men at the head of the mines and metallurgical plants. Investigations should be made of the reasons for labor turnover, in order to find ways to diminish the influence of this factor and to decrease the turnover itself. Training should be given to qualified men, as only highly trained workers can give maximum efficiency. The technical staffs should be increased, since the absence of a sufficient number is one of the basic reasons of the delay in properly organizing industry. ALEXEI P. MARADUDIN.

Ray, Ariz.

Separating the Geophysical Sheep and Goats

To the Editor of "E.&M.J.":

Your editorial on geophysical work in relation to locating and patenting claims defines very clearly the issues involved. Having had some experience in geophysical work and at the same time seen several "doodle bug" operators at work, I agree with you that it is of great importance to define legally the boundary line between bona-fide geophysical work and the hocus-pocus performances of the "ore finders."

The mining law should specify that, to be legally acceptable, a geophysical investigation method must be based on the comparison of measurements of recognized physical properties of the subsoil. A recognized physical property may be defined as a property that has been measured or is measurable by the methods used by the National Bureau of Standards. I believe that a definition of this character would eliminate all the mysterious rays, supernatural emanations, pendulum effects, and the like that are proclaimed by the proponents of the divining rod and "doodle bug" as the scientific basis of their exhibitions. WALTER KOCH.

New York City.

Consultation

Reasons for the Climax Milling Practice

"With reference to the article on the treatment of the Climax ore, appearing in the issue of March 23, I am puzzled by the explanation given with regard to the function of the bowl classifier. The author speaks of pulling the rougher circuit hard in order to carry over middling which will be separated in the classifier and ground separately in a special ball mill. However, when we examine the rougher circuit, we find it is composed of a rougher and a cleaner system. It appears to me that this frustrates the object of pulling over all the middling. In the froth obtained from the rougher cells, we may assume that most of the middling is carried over by 'pulling hard.' However, when this froth is sent to cleaner cells, it would seem that most of this middling will be dropped, since this is the function of a cleaner cell. The tailing of the cleaner cell is returned to the rougher cell. Hence, we have the condition that a froth is pulled hard to carry over middling, this rough froth then being sent to a cleaner system, which drops middling and sends it back to the rougher, so we are back where we started. A middling circulating load will build up between the rougher and cleaner systems, which, to reach equilibrium, will raise the grade of rougher tailing (to scavengers) and lower the grade of rougher concentrate.

"I am interested to know what the true state of affairs is, and whether or not my logic is erroneous."

Mr. William J. Coulter has kindly replied to the above inquiry as follows:

"We grind to 30 per cent on 100 mesh, and this is the product that we treat in our rougher circuit. Our concentrates run between 7 and 9 per cent on 200 mesh. It can therefore be seen that our regrind circuit has something definite to do. We have found that to obtain both a satisfactory recovery as well as satisfactory grade the product must be not over 10 per cent on 200 mesh when it enters the cleaner circuit; in other words, the rock must be ground to that fineness to break up the middling and liberate the molybdenum from the gangue.

Inasmuch as our ratio of concentration runs about 105:1, it is obviously poor practice to try to grind the entire tonnage to that mesh, and we are only interested in that portion of the tonnage which, after being ground to 30 mesh, contains any molybdenum. We have definitely proved that with the initial grind running between 28 and 30 per cent on 100 mesh we can, by pulling our rougher circuit hard through the use of both air and oil, bring up over 90 per cent of the molybdenum contained in the heads. This then permits us to get rid of the bulk of the tonnage via the tailrace and allows us to concentrate our efforts on the relatively small amount of ore which contains the molybdenum.

"The rougher froth before going to the bowl classifier is first treated in a clean-up machine, where still more of the barren gangue is dropped out. This machine is also pulled fairly hard, and the tailing from it goes back to the head end of the circuit at the classifiers. The froth from this machine then goes to our bowl classifier, which we have regulated so that the overflow gives us a product running between 5 and 10 per cent on 200 mesh. The coarser product from the bowl is reground in a small 4x4 mill and is in closed circuit with the bowl. When the bowl overflow goes to the cleaner circuit, we know that it has been ground sufficiently to give the desired results in both grade and recovery. The tailing from the cleaner circuit is split, part of it going back to the classifiers for dilution and the other part going to the clean-up machine from the roughers.

"To us this seems to be a very clear, straightaway, and practical method of treatment. We know beyond question that it has been the direct means of increasing our tonnage from 300 to 400 tons, or over 30 per cent, and it has also been the means of decidedly improving both our grade and recovery."

Names Wanted of Companies Using Electric Furnaces

"We note in 'Engineering and Mining Journal' of April 13, page 586, reference to mining companies using electric furnaces for making steel castings. If you are in possession of a list of mining companies using this furnace, we will be glad to receive this information."

Greene Electric Furnace Company, Seattle, Wash., has supplied the following information:

"The Consolidated Mining & Smelting Company of Canada, Ltd., is installing a three-ton Greene furnace for melting steel and iron electrically. This furnace will be installed in the Consolidated's foundry at Trail, B.C., and will make steel castings and also balls for grinding purposes.

"The Calaveras Iron & Steel Company is installing a Greene furnace which will be used for the same purposes and will supply castings to the local mining industry at and near Angels Camp, Calif."

Additional references to installations of the Greene furnace are made on pages 949-950 of the Dec. 15, 1928, issue of *Engineering and Mining Journal*. Any further information from readers regarding electric-furnace installations in mining plants, abroad as well as in the United States, would be most welcome.

Personal Notes

L. J. Parkinson, assistant managing engineer for Companhia de Diamantes de Angola, operating in Portuguese Angola, arrived recently from London

L. J. Parkinson

for several weeks' vacation in the United States. Companhia de Diamantes de Angola is one of the largest diamond producers outside the Union of South Africa and has recently completed mechanizing its alluvial workings. Mr. Parkinson expects to return to Africa via London and Europe about July 1.

R. D. Longyear, of Minneapolis, was in New York on business last week.

Everett Drennen, of Charleston, W. Va., has been elected a director of the Colorado Fuel & Iron Company.

L. H. Brooks is manager of Irma Mines, Inc., of Cooke City, Mont., which is now undertaking a diamond-drilling campaign.

J. H. Travers, formerly associated with the Lindsley interests in Canada, has been appointed resident engineer at Siscoe Gold, in the Rouyn district of Quebec.

J. R. Finlay, consulting mining engineer, of New York City, is making a professional visit to the Coeur d'Alene district. From there he will proceed to California.

M. F. Fairlie, mining engineer and manager of Mining Corporation of Canada, is moving his head offices from Cobalt to Toronto, Ont. His new address will be 350 Bay St., Toronto.

George D. Brooks has returned to Katowice, Poland, after a visit to the United States. **Frederick Laist** also expects to sail on May 8 to visit the Anaconda properties at Katowice.

A. J. Weinig, director of the experimental ore dressing and metallurgical plant of the Colorado School of Mines, addressed the Colorado section of the American Chemical Society on April 24 on "Some Chemical Phases of Flotation."

Walter Fitch, Jr., will sail for London from New York on May 8 on the "Aquitania" in connection with some foreign contracts. Mr. Fitch is president of the Walter Fitch, Jr., Company, shaft and tunnel contractors.

Arthur Selkhorne, field engineer for Mining Corporation of Canada, is organizing a prospecting party to explore the valleys of the Stikine and Iscut rivers, where indications of gold, silver, lead, zinc, and copper deposits were found last year.

Dale L. Pitt, general manager of Premier Gold, in the Portland Canal district of British Columbia, and Dr. **F. A. Kerr,** of the British Columbia branch office of the Canadian Geological Survey, are now in Honolulu. Dr. Kerr hopes to recuperate from the effects of overwork.

Alan Bateman, professor of economic geology at Yale University, sailed April 26 from New York for London on his way to visit the copper deposits of the Belgian Congo and Northern Rhodesia. Later he will attend the International Geologic Congress in South Africa, to be held in July and August.

J. D. Berry, of the American Smelting & Refining Company; **J. D. Bullock,** formerly at the research department of the electrolytic zinc plant of Anaconda Copper, at Great Falls, Mont., and now with Chile Exploration; and **A. A. Calusen,** of Braden Copper, Kennecott subsidiary, sailed for South America from New York on April 25.

Maurice W. Summerhayes has been appointed general manager of Wright-Hargreaves Gold, in the Kirkland Lake district of Ontario. Mr. Summerhayes succeeds **James E. Grant,** who resigned recently. The company has officially denied that Mr. Grant's resignation was caused by any difference as to production policies between himself and other officials.

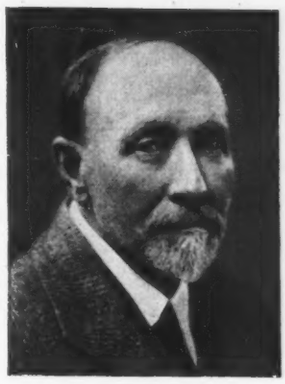
Quincy A. Shaw, a director of Calumet & Hecla Consolidated, has recently assumed the presidency of a newly formed mining investment and operating company, known as North American Mines, Ltd., of Boston, Mass. **W. Spencer Hutchinson** and **Robert Livermore** are acting as consulting engineers for the company. Various properties are being examined from time to time.

C. W. Wright, chief engineer of the mining division of the U. S. Bureau of Mines, has returned from a trip to Italy on personal business connected with the mines which he formerly operated in that country. While in Italy Mr. Wright investigated the progress of potash recovery. He found that a very promising patented process is about to be applied to the treatment of Italian lucite ores.

C. B. Kingston, consulting engineer in Northern Rhodesia to the Anglo-American Corporation of South Africa, which has holdings in all of the important Rhodesian copper mines, is resigning because of poor health. **Harold S. Munroe,** mining engineer, of Newmont Mining, which is associated with Anglo-American in its Rhodesian undertakings, will succeed Mr. Kingston. Mr. Kingston will leave his post some time in May. He has been in his present position since 1926. Mr. Munroe was responsible for the entry of Newmont Mining, American Metal, and United Verde Extension into the Namaqualand copper district, where they have acquired control of Cape Copper. Formerly he was general manager of Granby Consolidated, in British Columbia, and of Consolidated Coppermines, at Kimberly, Nev. In Rhodesia he will again be associated with Dr. **J. Austen Bancroft,** formerly assistant general manager of Granby Consolidated and now consulting geologist for Anglo-American.

OBITUARY

E. A. Haggen, mining engineer, died in Vancouver, B. C., on April 24 at the age of 70. Mr. Haggen was a native of New Zealand and a graduate of



E. A. Haggen

Otago University, in that dominion. He practised in New Zealand and Australia until 1897, when he went to Canada, where he engaged in mining journalism as well as mining engineering. He had been correspondent of *Engineering and Mining Journal* on matters pertaining to Alaska for several years.

C. P. Holtz, foreman of the Royal Tiger Mines, died on April 18 as a result of injuries sustained in a fall at the company's mine at Breckenridge, Colo.

E. E. Clark, chief mechanical engineer of Republic Iron & Steel at its iron ore mines at Bessemer, Ala., for more than 25 years, died on April 20 at the age of 62.

Robert E. Chambers, formerly manager of mines and quarries for Nova Scotia Steel Corporation, died at New Glasgow, N. S., recently at the age of 72. He was a native of Nova Scotia, but had been engaged in mining in South America. On his return to Canada he assumed charge of the Wabana iron ore mines for Nova Scotia Steel and had been associated with the company since that time.

Book Reviews

The Development of American Commerce As Seen by an Expert

"FRONTIERS OF TRADE." *By Dr. Julius Klein, with a foreword by Herbert Hoover. The Century Company, New York. Comprises 328 pages. Price $2.50.*

FEW MEN have the background for a discussion of American domestic and foreign commerce possessed by Dr. Julius Klein. His eight years as Director of the United States Bureau of Foreign and Domestic Commerce, a period of intensive development of trade at home and abroad, have given him an insight which makes him a leading authority on the subject. His recent promotion to the office of Assistant Secretary of Commerce is well merited.

Dr. Klein has the rare ability of picking the most important phases of commercial activity, and giving to these facts a personal touch which makes them applicable to business men as individuals. His writing is unusually readable and interesting, following the same style as is used in his delightful talks. In this book on the development of American trade and commerce he points out the revolutionary changes which have taken place during the present decade—how "Practices, methods, and ideals, all of which were once 'normal,' are today the most useless relics of antiquity," the result of "advancing machine technique, of superorganization and management, engineering, and equipment efficiency."

Such a rapid change in American production and distribution technique in this country has naturally brought out the question of international trade rivalry. But Dr. Klein points out that the enormous expansion of our importation of raw material as a result of war requirements "has been an indirect but invaluable contribution to the recovery of the European export trade." But Europe and America are still one another's best customers, for the "development of wants, accompanied by the growth of consuming power, has made possible the exportation of a great volume of American staples and specialties without diminishing the export trade of other countries in products special to them."

In discussing the European international cartels, Dr. Klein expresses the feeling that though they have not been as successful as had been hoped, "there can be no question that the cartel is at least a moderate improvement over its possible alternative, ruthless competition, especially with reference to intra-European trade."

The great economic changes since the war are set forth, and the conclusion is drawn that a "return to pre-war normalcy is but idle chatter." "Entirely new methods, new conditions, and new results" have been attained which make "utterly impossible any reversion to the industrial medievalism of pre-war years."

With this historical background, the author then turns to a contemplation of the prevailing obstacles to international trade and the efforts being made to remove them. He discusses trade barriers with their vexations and oftentimes irritating classifications; raw-material control by foreign nations; the outlook for agricultural products in Europe; and American investments abroad. The book concludes with several chapters on the internal trade developments of the important American customers and our present and past trade relationships with them.

Dr. Klein's work should be read by every business man. Its very readable style and background of fact and intimate experience make it a contribution on American trade and commerce which will find immediate acceptance by an unusually wide audience.

R. M. DAVIS.

LOW TEMPERATURE CARBONIZATION (OR DISTILLATION) EXPLAINED. *By Murray Stuart. Mining Publications, Ltd. Salisbury House, London, E.C. 2, England. Pp. 57. Price 4s.*

IT HAS long been known, says Mr. Stuart, that if coal is heated to about 425 deg. Centigrade, low-temperature distillation takes place, with the production of a distillate, which among other things contains primary oils, leaving a semi-coke or smokeless fuel which may be burned in the ordinary domestic grate. The particular yields obtained vary with individual coals. If oil shale be treated in this way, the solid residue has no value as a fuel. All the modern processes are making use of this phenomenon. The question is: Does a process achieve a desired result (including the question of whether the semi-coke is of suitable size for direct sale as a domestic fuel or whether it is so finely divided that it must be briquetted), and if so at what price per ton of coal treated? All the problems connected with the industry at the present day are economic ones. The actual operation was done successfully under full-scale commercial conditions 75 years ago. The only problem today is: can it be done again at a price which allows a profit to be made on the operation? Economic conditions vary in different parts of the world and even in different parts of Great Britain, Mr. Stuart points out, and a process might easily work at a profit at one place and not at another. The author then proceeds to recount the history of low-temperature distillation and to discuss the nature of the process and its scope. He shows how to calculate whether the industry can work at a profit and gives brief descriptions of various types of processes. No attempt is made to indicate the best process, because, he says, in the present status of the industry, there is room for every process which can work at a profit. He includes a table of low-temperature process yields and a bibliography.

TIN: SALIENT FACTS AND OPINIONS. *By J. A. Gallard and Murray Stuart. Mining Publications, Limited, London. Pp. 46. Price 2s. 6d.*

BASED upon the general theme of the absolute indispensability of tin to human needs today, and, in consequence, of the importance of securing wide public interest and understanding of the subject with a view to a just appreciation of the opportunities which it offers for profitable investment, this little booklet is inspired by the opinions and statistical presentations associated with the Anglo-Oriental Mining Corporation, whose spectacular appearance in the tin world is well known. Naturally, in so small a compass so complex a subject can be treated only selectively, but as it takes all kinds of people to make the world, so also there is room for a tract devoted to the favorable aspects from which it is possible to regard participation in tin ventures. Judicious selection is made from the writings of various well-known mining authorities, including President Hoover, but as the character of the tract is essentially propagandist it should not be regarded too critically.

E. BALIOL SCOTT.

"AN INTRODUCTION TO THE STUDY OF ORE DEPOSITS." *By F. H. Hatch. George Allen and Unwin, Ltd., London. Pp. 117. Price 7s. 6d. net.*

THIS short but well-handled discussion of ore deposits is of special interest to the beginning student of this subject, as well as to mining men who would refresh their memories on the formation of ores. The first chapter, an excellent short summary of early workers and their contributions, also points out present theories of ore genesis.

In Chapter II Dr. Hatch defines a number of the more common forms and in the remaining chapters, with the exception of the last, which is devoted to "The Forms of Ore Deposits," he briefly but clearly discusses various types of ore deposits. These are taken up from the standpoint of genesis, and reference is made to the world's more important deposits of each type.

The final pages contain a list of authors cited, a list of minerals referred to in the text, and a list of mines and mining districts mentioned in the text, each of which is useful as a reference.

DONALD M. FRASER.

NEWS OF THE WEEK

Summary

NEW BRUNSWICK station of U. S. Bureau of Mines will conduct large-scale tests on potash-bearing material from the Southwest to determine, if possible, its commercial value. Page 734.

* * *

Development of East Geduld, Daggafontein, and other mines on the Far East Rand indicates that these properties will help maintain Rand gold production when some of the older producers are worked out. Page 736.

* * *

International Nickel will employ about 6,000 men at its Sudbury properties when its construction program is at its peak. The permanent working force, when the Frood mine is brought into production, will probably be about 5,500. Page 732.

* * *

Developments at depth at the Wilbert mine, silver-lead producer near Arco, Idaho, show improvement. Company is obtaining electric power this month. Page 735.

* * *

Impressions of the Witwatersrand in connection with its geology and the problem of mining at the great depth attained by some mines there were discussed by Prof. L. C. Graton at a meeting of the New York section of the A.I.M.E. last week. Page 733.

* * *

A new gold strike has occasioned considerable excitement and still more stock selling in the Bullfrog district of Nevada. Page 732.

* * *

Lake Shore Mines is developing new ground above the 1,000 level of its mine at Kirkland Lake, Ont., in the belief that it has found the real extension of the main vein. Page 734.

* * *

Lead mining promises to become as important as gold mining in Mohave County, Ariz., as a result of developments near Kingman. Page 735.

New Discoveries Result in Increase of Grade and Output at Walker Mine

PRODUCTION of Walker Mining, 8 miles from Spring Garden, Plumas County, Calif., has been increased to 1,200 tons of copper ore daily. By June 1, through the addition of more equipment, the capacity of the company's flotation mill will have been augmented to 1,800 tons daily. Building will be limited to additional space for one unit of the ball-mill section. Additional Callow flotation cells will be installed, as well as a new Marcy ball mill and a new Dorr classifier. Coarse-crushing equipment now installed will be adequate to handle the increased output.

Marked improvement has been shown at the property as the result of new ore discoveries. Mill heads have risen to 1.8 per cent copper and the management expects that in a short time this figure will be increased to 2 per cent.

In the 712 orebody, lying 1,000 ft. north of the nearest orebody, the average width is 15 ft. for a length of 700 ft. The grade ranges from 7 to 12 per cent copper. During the first week in April, 970 tons broken in this orebody averaged more than 9 per cent copper. The Piute orebody has been developed for 1,300 ft., with the ore continuous for the entire distance. Width of this deposit is 40 ft. and the average grade is 2 per cent copper. A raise has followed ore up for a distance of 500 ft. on the dip of the formation.

Of interest is the fact that, in the original development work, the 712 orebody was missed by 12 ft. The Piute orebody was struck first. Later, in diamond drilling, the 712 deposit was found, although the first hole passed through the deposit in a lean streak and failed to show ore. Had the 712 orebody been found first, discovery of the Piute deposit would probably have been delayed for months.

More than 250,000 tons of ore is broken in the stopes, ready to be hoisted at any time. Probable and possible ore is estimated at 7,000,000 tons. During the first three months of 1929, Walker paid off $150,000, of its indebtedness to International Smelting, an Anaconda Copper subsidiary which also owns a large block of Walker stock. This is nearly three times as much as was paid in 1928. The entire indebtedness now amounts to $630,000, and the company expects to pay this all off by Jan. 1, 1930.

During the first two weeks of April, operating profit was at the rate of $108,000 a month, after allowing $20,000 for development work. March gross receipts amounted to $233,525; mining, milling, tramming, and development expenditures totaled $90,614; and smelting, railroad, and refining costs were $28,988, leaving an operating profit of $94,057 and a net profit of $82,131, after depreciation and interest.

In 1928, the average cost of mining, milling, development, and tramming was $2.55 a ton, or 12.92c. per pound of copper produced. Total production was 10,356,742 lb. of copper, 21,961 oz. of silver, and 13,011 oz. of gold from 391,275 tons of ore. Operating profit was $304,770 and net income was $176,121.

Some Abana Shareholders to Try to Oust Directors

A SO-CALLED "shareholders' protective committee" has been formed by a group of shareholders in Abana Mines, Ltd., which operates in the Rouyn district of Quebec, and it is asking shareholders for proxies so as to elect a new board of directors at the annual meeting of the company in Montreal on May 27. The members of this committee claim that the best interests of the shareholders were not properly protected by the directors who have been in control.

Several months ago new interests acquired a substantial holding in Abana and advanced funds to continue development, as the company had no cash and the mine had been allowed to fill with water. Mill construction was postponed on the advice of M. W. Summerhayes, and development work is being continued.

Wellington Mines Closes

Operations have been suspended at the property of Wellington Mines, in the Breckenridge district of Colorado, one of the largest lead-zinc camps in the state for the last 40 years. This closing is said to be permanent, and much of the machinery at the mine and the two mills is being shipped to the Shenandoah-Dives Syndicate property, in the Silverton district, for use in a new mill being constructed there.

Dividend payments by Wellington Mines amounted to more than $2,000,000 on a capitalization of $1,000,000.

International Nickel Will Soon Employ 6,000

AT THE PEAK of building activity at the International Nickel properties, in the Sudbury district of Ontario, about 6,000 men will be employed altogether in the mines, smelters, and construction. Some of this payroll will, of course, be temporary, but even after construction is completed, estimates place the number of men who will be employed by International Nickel, Ontario Refining (which will operate the new copper refinery), and Canadian Industries (which will construct a sulphuric acid plant at Sudbury), at about 5,500, as compared with 4,000 employed at present.

Construction work on the new smelter is being pushed vigorously, with about 1,085 men employed entirely on construction. This plant will treat Frood ores. The first brickwork on the new stack was started this week, and the occasion was marked by the presentation of a silver trowel to John L. Agnew, vice-president in charge of operations for International. The stack will have a total height of 510 ft. 6 in., with an inside diameter of 45 ft. and an outside diameter of 60 ft. at the base. When completed it will be the tallest in Canada. It will be built by Canadian Custodis, Ltd.

Steel work has been started on the converter building. Dominion Bridge is doing the steel work and Fraser, Brace & Company is the general contractor.

A party of engineers and technical representatives of American Metal visited Copper Cliff last week for the purpose of examining the proposed refinery site. Plans of the new plant are now being prepared, and actual construction will start within the near future. International Nickel and American Metal will hold jointly an 80 per cent stock interest in Ontario Refining, the operating company. Consolidated Mining & Smelting will have a 20 per cent interest. Ventures, Ltd., will probably share in the Consolidated holding, although the extent of its interest has not been made public.

Copper Mines Decrease Wages, Effective May 1

AFTER four successive increases in wages—amounting to $1.25 daily in Montana mining districts and 25 per cent of wages prior to Oct. 1 in most of the other Western camps—the copper producing companies have posted notice of decreases in wages effective May 1, as the result of the failure of the price of copper to stay above 19c. a pound in the New York market. This decrease was expected, as the third increase, made effective in March, was accompanied by a notice to the effect that it would remain in force only so long as copper stayed above 19c. The decrease amounts to 25c. daily in Montana districts and to 5 per cent of wages prior to Oct. 1, 1928, in the Arizona districts. In Nevada and Utah the decrease is made in proportion to the wage. Miners' contract prices have been adjusted accordingly. The basic daily wage in Butte, after the reduction takes place, will be $5.75 daily, the highest in any period up to this year.

N.A.M.E. Exploration at Crow River Favorable

TRENCHING on the Crow River properties of the Northern Aërial Minerals Exploration, in the Patricia district, Ontario, has shown good results. In the eastern section of the discovery five trenches have been run over a length of 250 ft. A limited amount of trenching has been done west of this, and promising results have also been obtained. On the Connell properties diamond drilling is still being carried on. The first few holes gave indifferent results, but since they were put down some promising ore intersections are understood to have been encountered.

Planes are running regularly to the new camp, and no difficulty is found in obtaining transportation. During the coming summer at least 70 planes will be employed for the various mining sections throughout northern Canada. A considerable number of these are privately owned. Western Canada Airways and other companies have planes available for all types of service.

Newmont Takes Over North Star, in Grass Valley

SAN FRANCISCO, April 30, 1929.—Newmont Mining, which announced about two weeks ago that it had acquired the entire property of Empire Mines, at Grass Valley, Calif., has also taken over the North Star mine, which shares with Empire the distinction of being the largest producer in the Grass Valley district. A new company, in which Newmont will have a 51 per cent interest and former North Star stockholders will have 49 per cent, is being formed under the name of Empire Star Mines. H. W. Hardman will be resident manager. North Star Mines has produced about $30,000,000 in gold since 1884 and has paid almost $6,000,000 in dividends.

Will Ship High-Grade Copper Ore From Big Indian

Preparations are being made to ship rich copper "float" from the Big Indian property, in San Juan County, Utah, 30 miles south of Moab and 60 miles south of Thompson's Springs, the nearest railroad point on the Denver & Rio Grande Western. This deposit, a replacement in the sandstone, has been developed from time to time and several milling projects launched. Now the management is planning to ship nothing but ores assaying 10 per cent copper or better lying on the surface, of which there is estimated to be about 1,000 tons.

Annual Nevada Gold Boom at Bullfrog This Year

A TYPICAL Nevada gold stampede has followed the discovery of rich ore near the old Carrara marble quarries, south of Bullfrog, Nev. Coarse gold is found in a compact quartz ore in a shear zone in limestone. The gold is disseminated through the quartz, with little in the cleavages. An experienced prospector, Jim Shea, who had picked up rich float, found the vein on claims of Gold Ace Mining, about 1,000 ft. southeast of the tunnel workings that have been supplying 80 tons of $10 ore daily for the company's amalgamating mill.

Reports by G. Raymond Boggs, president, and Briz Putman, superintendent, say that the fracture zone is 40 ft. wide, including 3 to 4 ft. of high-grade material. The surrounding territory has been located for miles and the usual flood of penny promotions is in prospect.

A.S.&R. Installs New Pump at Silver Reef

A second Rumsey Triplex pump, with a capacity of 125 g.p.m. for a 460-ft. lift, has been installed at the Silver Reef property in Washington County, Utah, where American Smelting & Refining is conducting operations. Two laterals are being advanced from the three-compartment shaft. One on the 300 level will connect with the Leeds incline shaft, and prospect the mines on the White Reef, and the other on the 460 level will unwater the mines on the Buckeye Reef. Progress is averaging about 10 ft. daily in each of the two headings.

Fire Destroys Surface Plant at Dickens Mine

Fire recently destroyed the compressor building and other surface equipment at Dickens Consolidated, Coeur d'Alene district of Idaho. Damage was estimated at about $25,000, and reconstruction has been started. Most of the loss was covered by insurance. No one was hurt, and the company's new mill was not damaged, but operations underground will be hindered.

As quite a large accumulation of ore is on the dump, the mill may be able to continue operations until mining is again possible.

M. I. T. Holds Open House

On Saturday, April 27, the Massachusetts Institute of Technology held its seventh annual open house, under the auspices of the combined student professional societies. Department exhibits showed the wide range of Institute activities.

Prof. L. C. Graton Discusses Rand Geology and Deep-Mining Problems

New York Section of A.I.M.E. Hears Placer Theory Criticized—Tribute Is Paid to Technical Ability and Co-operative Methods of South African Consulting Engineers

IMPRESSIONS of the Witwatersrand, in South Africa, with particular reference to the geology of the gold-bearing conglomerates and the problems involved in deep mining there, were presented by Prof. L. C. Graton, of the department of geology at Harvard University, at the regular monthly meeting of the New York section of the A.I.M.E. held on April 24. Professor Graton's remarks were based on a visit of six weeks which he made to the Rand last February and March in the course of an extended trip to many of the world's deepest mines.

In discussing the manner in which the gold found its way into the conglomerate beds of the Rand, Professor Graton first outlined the two principal hypotheses which are held by the geologists of South Africa—namely, the infiltration theory and the placer theory. Although the placer theory is accepted by most of the geologists, both on the Rand and elsewhere, Professor Graton took exception to it, contending that the gold was deposited in the conglomerates by hydrothermal solutions emanating at depth from a magmatic reservoir. The following observations were presented in support of this contention:

1. The highly silicified character of the conglomerates.
2. Presence of quartz, pyrite, sericite, and chlorite in the conglomerates.
3. Intimate association of gold with small seed-like bodies of carbon at the bottom of the conglomerates.

The translucent to almost transparent character of slabs a half inch in thickness from the conglomerate beds was noted in connection with the silicification, and attention was drawn to the fact that the four minerals mentioned as associated with the gold were commonly found in gold deposits of magmatic origin. Difficulty of accounting for the presence of gold with the carbon bodies under the placer theory was evident in that, when immersed in water, the specific gravities of the gold and carbon vary in the ratio of 35 to 1.

A glowing tribute was paid the consulting engineers of the Rand mining companies by Professor Graton with the words: "On the Rand is the greatest collection of mining brains in the world." The technical ability and the co-operative attitude of these members of the mining profession in solving their common problems and in sharing their knowledge and experience were most impressive to a visitor.

Deep mining is entering a rather uncertain stage on the Rand, Professor Graton pointed out, and the outcome of such operations there will undoubtedly have a marked influence on the extent to which mineral deposits in other sections of the world are exploited at considerable depth. Evidently, changes or alterations must be made in the present practice employed on the Rand—that is, if operations such as those at the Village Deep mine, which exceed 7,300 ft. in vertical depth, are to be extended downward and, at the same time, a sufficient margin is to be maintained between operating costs and revenue.

Excessive use of water in the stopes, resulting in the hot atmosphere at depth becoming saturated with moisture, greatly reduces the capability of labor, and hence the amount of work that can be performed. A comparison, unfavorable to the Rand, was drawn between the underground atmospheric conditions on the lower levels of the Village Deep mine and those at the same depth in the St. John del Rey mine, which Professor Graton had visited a few weeks prior to his visit to the Rand mines.

Rock pressures on the deep levels of the Rand mines are becoming an increasingly important factor. Stope-supporting cribs must be closely spaced, and their construction must follow close to the face as the ore is extracted. This condition tends to slow up mucking (known as lashing on the Rand) and other stope operations. A proposal made by the speaker in discussing this situation was that the open stoping method employed be replaced by a retreating-caving method.

Employment of large numbers of African laborers—4,500 on a single shift at one property—all of whom, in addition to ore and supplies, must be transported through a single shaft, or a single shaft system, reduces to a serious extent the effective shaft capacity at deep mines. Mechanization of many underground operations now performed by natives, and a consequent reduction in the number of such workers employed, was considered by Professor Graton a remedial measure for this condition. Inflexible government regulation of the South African mining industry, requiring that extraction operations be confined to one shift, he thought a great obstacle to the lowering of operating costs, particularly where operations were at depth.

Following Professor Graton's talk, the meeting was given over to discussion, in which F. Hellman and T. H. Leggett, among others, took part. The presiding officer at the meeting was R. M. Roosevelt, chairman of the section.

Toric Shareholders Ratify New Option to Britannia

SHAREHOLDERS of Toric Mines have ratified a new agreement with Britannia Mining & Smelting, Howe Sound subsidiary in British Columbia, after arrangements for the bonding of the property by Russo-Asiatic Consolidated, of London, had fallen through. Last fall Britannia bonded the property and conducted a thorough sampling and geological survey of its holdings, but the Toric shareholders failed to ratify the agreement, and Britannia, which was in charge of the property, retired.

By the new agreement, Britannia will assume the liabilities of the Toric company, amounting to $39,000, and will form a new company with a capitalization of $3,000,000 in $1 shares. The shareholders of Toric Mines will be given 750,000 shares in the new company in consideration for the mine and all of the company's assets. Britannia is to have the choice of either of two options on these 750,000 shares. It may purchase 100,000 shares within 18 months at 95c. per share; 150,000 within 30 months at 95c., 200,000 within three years at $1; and $300,000 within five years at $1.37½; or it may buy the whole block of 750,000 within two years for $500,000 cash.

The Toric mine is in the upper Kitsault Valley, in the Alice Arm district, of British Columbia, and is provided with a 60-ton mill. A large tonnage of ore, said to average around $12 in gold and silver, has been exposed by two crosscut tunnels and connecting drifts.

New Company Will Build Mill for Ardsley Butte

Ardsley Butte Milling Company, a South Dakota corporation, has been organized to erect a 150-ton mill close to the collar of the shaft of the Ardsley Butte Mines Corporation at Butte, Mont. The officers of the milling company are nearly identical with those of the mining corporation. Ardsley Butte Mines Corporation shipped 21 cars of high-grade silver ore in the first seventeen days of April. Recently the Northern Pacific Railway announced that it would build a spur to tap the mines of the southwest district of Butte, this being the first long spur built by the railroad company in the Butte district in twenty years.

Copies of Mines Committee Hearing Now Available

Printed copies of the hearings before the Senate Committee on Mines and Mining, at which the needs of the mining industry were discussed, are now available. The hearing covers 98 printed pages. Copies may be obtained gratis on application to Paul Wooton, correspondent of *Engineer and Mining Journal*, National Press Building, Washington, D.. C.

Utah Mining Engineers Air Their Views on Education

THEORY or practice? Fundamentals or details? In which should the student of mining engineering, metallurgy, or geology be most thoroughly grounded? This question was threshed out by the Utah section of the A.I.M.E. at its regular April meeting, held at the University of Utah under the auspices of the junior section of the School of Engineering, with John M. Boutwell presiding. Weight of opinion was largely in favor of a general or theoretical education in the various branches of the mining industry.

"Give us the young man thoroughly trained in the theory of his profession," said A. B. Young, assistant manager of International Smelting, "and we will furnish the practical experience. The school is the place for a complete grounding in mathematics, chemistry, and physics, the foundation upon which the superstructure is reared. The world is the place for the acquisition of practical knowledge. We in the outside world cannot train the graduate in theory, but we can give him more practical training in a week than the school can afford in a month. Furthermore, the training will be given in such a manner as to fit the young man for our practice. For that reason, all other things being equal, we would prefer the man who has had no previous experience with other organizations. He comes to us unroutined, with an open mind, and is more easily adapted to our needs."

The futility of attempting to give a broad engineering education in four years of college was pointed out by W. S. Reid, assistant superintendent of the Murray plant of American Smelting & Refining. "Specialization to a certain extent is very desirable," said Mr. Reid, "but if overdone it will actually prevent advancement beyond the distinctive speciality. The successful mining and metallurgical engineer of today must be a very versatile person. A mining or metallurgical engineer must be skilled in the sciences, but he must be able to maintain an efficient working force. He will find his duties are social as well as technical. Therefore, his success is likely to be proportionate to the degree in which he has broadened out."

As an antidote to a too narrow scientific training, Mr. Reid emphasized the need of thorough training in languages, literature, public speaking, natural sciences, psychology, economics, and the social sciences. "Among these studies," he added, "I would include some honest-to-God English courses, not Engineering English." Any type of manual labor, Mr. Reid said, was valuable training, as it taught the student the use of his hands and what to expect from labor in the way of work, which of itself is a most important step in engineering.

According to J. A. Norden, general manager of Utah-Apex Mining, most graduates want to start in the office. "That is all wrong," he said. "We have too many office men now. What we want is men in the operating departments with the will and the enthusiasm and the training to put into effect the schemes that we work out in the office.

"A successful engineer is a leader of men, particularly a mining engineer," added Mr. Norden. "His work may carry him to the ends of the earth, and wherever he goes he will be called upon to formulate policies of action and conduct. If he cannot do this, his entire work will fail. The industry needs men with sound training in fundamental sciences: men who are not afraid to work, who have initiative and a sense of business values; men who can inspire in others the utmost in co-operation and helpfulness."

In discussing the requirements for a thorough training in mining geology, Guy W. Crane, consulting geologist for the Chief Consolidated Mining Company, pointed out how superior the curriculum of the present day school is to that of a generation ago. Courses are now more comprehensive and are better planned.

New Brunswick Station to Test Southwestern Potash Ores on Large Scale

By Paul Wooton
Special Washington Correspondent

WITH the additional money recently made available for the conduct of chemical and manufacturing research looking to the recovery of potash from lucite, alunite, and other potash-bearing minerals, the U. S. Bureau of Mines is about to undertake large-scale tests at its New Brunswick experiment station. Owing to the fact that laboratory work on potash has been conducted intensively since the drilling appropriation was made available two years ago, enough work of this sort has been done to allow an immediate start on larger scale experiments. The work will be under the immediate supervision of H. H. Storch, the supervising engineer of the New Brunswick station.

Under the terms of the act which bears the name of Representative Winter, of Wyoming, $150,000 is authorized for this research. It will be expended over a period of three years. The money is to be spent jointly by the Bureau of Mines and the Bureau of Soils. Because it will be necessary to purchase evaporators, autoclaves, and calciners, $33,000 has been allotted to the Bureau of Mines for this year's work. The remaining $17,000 will be expended by the Bureau of Soils. Hereafter the appropriation will be divided equally between the two bureaus.

The laboratory tests which have been conducted thus far have demonstrated that polyhalite, which has been found over a wide area in the Southwest, can be treated at a reasonable cost, to yield potassium sulphate and the double sulphate of potash magnesia. Under the new appropriation the studies can be extended to the other potash-bearing minerals.

The Bureau of Mines is now drilling its twelfth well in the Red Bed area of the Southwest. Some of the wells sunk have been bored with the idea of delimiting the area. Before the end of the three-year drilling program it is expected that very definite information will be had as to the points where the potash content is highest.

After two months of preliminary work and adjustment the first unit of the Bureau of Mines' helium plant at Amarillo began regular operation April 11. It is now producing helium at the rate of 30,000 cu.ft. per day. The gas being produced is 97 per cent pure, a much higher degree of refinement than was attained at the Bureau's plant at Fort Worth. At this rate of production, the Bureau expects to be able to furnish helium to the army and navy at a price less than $20 per 1,000 cu.ft. It is anticipated that this unit will be able to supply the entire requirements of the army and navy. The navy's present annual requirements are 8,000,000 cu.ft. and those of the army 2,500,000 cu.ft. The second unit of the plant, which has equal capacity, will probably be ready Sept. 1.

Lake Shore Opening New Ground Above 1,000 Level

RECENT developments at Lake Shore Mines, in Kirkland Lake, Ont., continue to emphasize the importance of the latest discovery. In the eastern section of the Lake Shore property ore in the north vein is confined to one fracture. On the western section of the mine, however, the fracturing is distributed over a wider area. Apparently development in the western section of the mine down to a depth of at least 1,000 ft. had been on a subsidiary vein until lately, and what is now being developed is actually the main break. This means that above the 1,000 level, for a length of approximately 1,800 ft., the main break has never been explored, and the work now being done is showing widths of 12 to 14 ft. of ore running approximately $20.

Below the 1,000 level work is being done on the main break. The possibilities of the subsidiary vein are still unknown. These new developments not only add greatly to the ore reserves and length of life, but will also help to maintain the grade at about $16 a ton.

Surface plant at Wilbert Mining, near Arco, Idaho

Developments at Depth at Wilbert Are Favorable

PRODUCTION of Wilbert Mining, 40 miles from Arco, Butte County, Idaho, has been materially augmented by ore developments on the 1,350 level. Up to date, about $2,000,000 has been taken from the oreshoot, which has been productive from grass roots. Some time ago a tunnel was driven into the formation to cut the deposit, lying along a quartzite-limestone contact, on the 1,100 level. In working the orebody up to the 850 level, where stoping from the incline shaft had been stopped, the mineralization was leaner.

However, below the 1,250 level definite improvement began to show, and on the 1,350 level the oreshoot has been opened up for a length of 230 ft. without finding its lateral limits. At the north face, the ore has averaged 35 to 40 per cent lead and 9 to 15 oz. of silver to the ton over a width of 5 to 8 ft. Numerous cross fissures and the exposure of igneous intrusions, conditions not prevailing on the upper levels, convince J. A. Foley, manager, that as the source of mineralization is approached, the deposit will gain in strength and size.

By May 10 the company's mining and milling plant will be connected up with the power line being extended 17 miles to the property by Utah Power & Light. Use of electrical power will cut operation costs about half, according to Mr. Foley. A new Bury compressor, supplying 450 cu.ft. of air per minute, is to be installed to supplement the Chicago Pneumatic compressor now being used. The company intends to sink another shaft from the tunnel level nearer the orebody. Ore at the Wilbert is concentrated by the gravity method into a product assaying from 60 to 65 per cent lead and from 14 to 20 oz. of silver. Earnings of the company have been increasing steadily since January. Net revenue will amount to $15,000 in April. Concentrate is shipped to Salt Lake Valley smelters.

Several Park City Mines Change Hands

ANNOUNCEMENT has been made by M. J. Dailey, general manager of Silver King Coalition, operating in the Park City district, Utah, that the Kearns interests and associates will finance a development project to be carried on from Silver King's Spiro Tunnel. This development will be known as Silver King Western and will involve the Scottish Chief, Iowa Copper, Western Monitor, and other properties.

Clarence and Ernest Bamberger have organized a company, called Silver King Extension Mining, to develop the Clegg group, northeast of Park City. This company has no connection with Silver King Coalition, and its properties do not adjoin Silver King Coalition ground.

Park Premier Mining, a subsidiary of International Smelting, recently acquired control of the Park Berg group. Either through its subsidiaries or directly, International Smelting now controls about 6,000 acres in eastern Park City. The Park Konold shaft, 400 ft. deep, will be unwatered and diamond drilling started. A churn drill went into operation recently on the Park Nelson property, also controlled by International, preliminary to selecting a shaft site. Tunneling is being done on the Park Premier group.

Sinking of the Park City Consolidated shaft has been stopped at a depth of 350 ft., and drifting has been started on the 300 and 350 levels to explore the extensions of the orebody struck at 260 ft. in the shaft.

Rebuild Little May Plant, in Tintic District

The compressor house destroyed by fire on the South Standard lease of Little May Mining in the Tintic district, Utah, has been rebuilt and the machinery put in condition. Two crosscuts are being run, one toward the Iron Blossom fault and the other to the intersection of the Eureka Standard fissure with the Iron Blossom fault, about 70 ft. distant.

Mohave County's Lead Mines Assume More Importance

LEAD mining activity in Mohave County, Ariz., is beginning to rival that of the gold camps. Monarch Lead, which owns the Tennessee mine, near Chloride, is building a 100-ton selective flotation mill. A new electric double-drum Ottumwa hoist has just been installed and concrete foundations for a new 68-ft. steel headframe have been constructed. The old wooden headframe will be kept in use until the steel for the new one has been delivered.

The company is operating two compressors, a 1,000-cu.ft. capacity Ingersoll-Rand and a 480-cu.ft. capacity Sullivan. The ore contains principally lead and zinc, with a little gold and silver. At present, the shaft is 1,400 ft. deep, and about two miles of underground workings have been opened. The mine produced its first ore about 1897, and was operated at one time by U. S. Smelting Refining & Mining.

Payroll, also near Chloride, has a new 50-ton mill almost ready for operation. The ore contains gold and silver in addition to the lead content.

Old Colony Mines, at its property, 12 miles north of Kingman, has spent about $150,000 in development work. In a progress report, recently issued in Toronto, where the company's offices are located, Will Halloran, the superintendent, estimates reserves of positive, probable, and possible ore at 960,750 tons of ore averaging $25.90 a ton, containing 12 per cent lead, 5 per cent zinc, 0.5 per cent copper, and some gold and silver. The company has a 50-ton flotation plant now on the property, and, by rearranging equipment, with some minor additions, it expects to be able to handle 100 tons daily. A crew of about 45 men is now engaged on the property. At present equipment is being brought to the portal of the 4,200 tunnel level, which will probably be the main haulage tunnel. When development work is completed, E. E. Campbell, general manager of the company, believes that construction of a new mill of a capacity of at least 200 tons daily will be justified.

Canadian interests are also developing the Democrat property, in the Wallapai Mountains, 20 miles southeast of Kingman. A 4-mile road has been built to connect the property with the Big Sandy highway, and a shaft is being sunk to a depth of 150 ft. on a vein 4 ft. wide.

Tom Reed and Katherine Gold, both of which have been troubled by excessive water, have evidently successfully solved their problems in this connection. These two properties are the foremost gold producers in the county. Tom Reed has pumped out its winze and is sinking from the 800 to the 900 level. At the Katherine mine, bulkheading on the 900 level has enabled the pumps to handle the flow of water. S. H. Brady, the new superintendent, is having the mine re-sampled from the 600 level to the surface.

Johannesburg Letter

By Owen Letcher
Special Correspondent

Expect Rand Production to Be Maintained by New Mines in Eastern Section

Johannesburg, March 30, 1929.—Production from the mines of the Central, Near East, and Western sections of the Witwatersrand district began to decline several years ago, and, with the exception of Crown Mines, none of the properties in the older parts of the district can bear comparison today with the great mines east of Boksburg, at least so far as dividends are concerned. These Far East Rand mines have huge areas of mining ground, and most of them have long lives assured. But even the largest of mines must sooner or later come to the end of its tether, and this fact is realized by shareholders and government officials who are interested in maintaining the production of the world's greatest gold field. In this same area, however, are two properties now in the development stage that seem destined eventually to take the place of mines that will soon drop out of the list of producers. These two mines are East Geduld and Daggafontein.

CONCERNING the plans for the development of Daggafontein I wrote in my last letter. At East Geduld the new area now being explored has given better results than were expected. Announcement of the plan for bringing this property into production, both from the technical and financial aspects, is expected within a few weeks.

Progress at East Geduld and Daggafontein should draw attention to the Grootvlei property, which adjoins both, when development in that direction is started by these companies. At present development at East Geduld is confined to the opposite side of the property, and probably several years will elapse before connections with the Grootvlei workings are established. Both East Geduld and Daggafontein are depending on their established neighbors for ventilation, and, with this assistance, they intend to reach production with a single shaft. Later, however, additional shafts will undoubtedly be sunk at East Geduld to reduce its dependence on Geduld.

A question that is attracting much attention among mining men here has been raised by *The Rhodesian Mining Journal*. Why is it, this publication asks, that in two important instances large metallurgical installations in Rhodesia have failed to corroborate the results obtained in pilot plants? Specifically, this question refers to the disappointing zinc recoveries at the Rhodesia Broken Hill electrolytic zinc plant and to the trouble met in operating the Bwana M'Kubwa plant, near N'Dola.

Rhodesia Broken Hill's plant started operating early last year and was designed to produce 1,500 tons of zinc a month, or 18,000 tons yearly. This production has never been attained, and the best output to date was just short of 1,000 tons a month. The pilot plant, after several months of operation, gave the management data which indicated a recovery of three tons of zinc for every ton of sulphuric acid used. Actually, however, the average zinc output per ton of sulphuric acid has been only 1.6 tons. Additions are now being made to the sulphuric acid plant to increase the zinc returns.

It is no secret that the pilot mill at Bwana M'Kubwa gave results that were considerably more satisfactory than those obtained from the large plant. Various alterations and additions to the Bwana plant have been made by C. W. Dowsett, the company's general manager, and the results have been considerably improved, but the data obtained from the pilot plant are now generally admitted to have been largely erroneous.

The pilot plant installed on the Copper King and Copper Queen mines of Southern Rhodesia Base Metals, in the Sanyati Valley, Southern Rhodesia, is now in operation at the same company's Alaska mine. Disappointments at Copper King and Copper Queen were probably due more to optimistic estimates of the tonnage and value of the ore rather than to other causes.

Copper developments in Northern Rhodesia have been so generally satisfactory, however, that financial interests are now trying to secure concessions on every available square inch of territory in South Central Africa. The Edmund Davis-Chester Beatty-Rhodesian Anglo-American interests have secured nearly all the favorable ground in Northern Rhodesia, and during the coming dry season an expedition will be dispatched to the Angola border.

Recently Leslie Urquhart, of Russo-Asiatic Consolidated, dispatched a preliminary prospecting expedition to explore the North Charterland company's area. At the beginning of the year Mr. Urquhart concluded negotiations whereby he secured exclusive prospecting rights over the 10,000 square miles of the North Charterland concession, extending from Fort Jameson to the Luangwa River. Although no important discoveries of copper have been made in Nyassaland, some promising asbestos occurrences have been noted in the N'Cheu district, and probably this territory will soon be subjected to a thorough search.

Bonanza to Explore 500 Level

The raise put up by Bonanza Mining in its Park Bingham lease, adjoining the United States mine at Bingham, Utah, has entered the "B" limestone 475 ft. above the Butterfield tunnel level. Drifting will be started on the 500 level. Two headings are being run on lower levels, one on the 100 level and the other on the Butterfield tunnel level.

Mexico City Letter

By W. L. Vail
Special Correspondent

Doubt If Extra Session of Mexican Congress Will Be Called Now

Mexico City, April 26, 1929.—President Portes Gil, according to reliable reports, will probably not call an extra session of the Mexican Congress, as was originally expected, for the purpose of considering the proposed labor law and the question of mine legislation to remove some of the barriers that are now hindering develoment of the country's mineral resources. The decision to postpone the extra session is said to have resulted from the existing political situation, which is still very uncertain as a result of the revolution. Although the threat of the revolution, for the time being at least, has disappeared, political reorganization and the pending Presidential elections will occupy public attention to the exclusion of many economic problems. In the meanwhile, various business organizations continue to gather data for presentation to the government bearing on the labor question, which is so vital a matter at the moment.

IN CHIHUAHUA only those operations that have not yet obtained sufficient fuel supplies are still to return to normal. Incidentally, a new dam is being constructed south of Meoqui, on the Conchas River, in this state, and probably will be available for power purposes by the end of this year.

At the Santa Maria de la Paz mines, at Matehuala, San Luis Potosi, development work on the lowest level of the mine shows that the grade of ore is being maintained. In addition, a new vein is being explored. Production from the mine is the greatest that it has been in the last three years, and is now averaging 2,400 kilograms of silver a week.

R. H. Jeffrey, formerly manager of Mazapil Copper, with headquarters in Saltillo, and now managing director of the company, recently returned to England after an exhaustive survey of his company's properties at Saltillo and Concepcion del Oro, Zacatecas. He was satisfied with the situation at the company's mines.

Some trouble has been experienced in the operation of the new flotation and cyanide plants of Chontalpan, at Xitinga, but these difficulties have been practically overcome, and the company expects to have the plants working at capacity by October. At present the plants are making a recovery of about 80 per cent. The capacity is 150 tons, and the ore reserves at the mine are said to be about 350,000 tons. The company is considering doubling the present capacity of the plant, if development work justifies such a move.

MARKET AND FINANCIAL NEWS

Inspiration Earnings Up 375 per Cent

INSPIRATION Consolidated Copper Company's net income for 1928 totaled $3,465,539, an increase of 375 per cent over the $729,694 reported in 1927. Distribution of copper production for 1928 compares with that for 1927 as follows:

Production

	1928 (Pounds)	1927 (Pounds)
From concentrating ores	38,313,520	36,909,508
From leaching ores	49,692,724	51,284,096
From direct-smelting ores	117,067	180,415
Total	88,123,311	88,374,049

Income accounts for 1928 and 1927 compare as follows:

Income

	1928	1927
Sales of copper	$14,049,860	$12,817,599
Operating expenses, including federal taxes	9,540,200	10,885,097
Depreciation	752,284	751,897
Gross profit	$3,757,375	$1,180,605
Other income	38,904	32,718
Total income	$3,796,279	$1,213,323
Interest	330,740	483,629
Net income	$3,465,539	$729,694
Dividends	886,475	295,491
Surplus	$2,579,064	$434,203
Previous surplus	7,121,081	6,686,879
Profit-and-loss surplus	$9,700,145	$7,121,082

W. D. Thornton, president of the company, in his remarks accompanying the annual report, states that last year Inspiration Consolidated, in common with other copper producers, benefited by the change in the statistical position of the metal. The average price for the year as reported by the *Engineering and Mining Journal* was 14.57c. per pound. Inspiration's production for 1929 will show a material increase over that of 1928.

Conditions in the Live Oak section are no better, but the changes made in the mining system have resulted in lowered costs and an increase in the grade of ore mined from this section. A material reduction in the copper content of the leaching plant tailing was obtained by the removal of the major portion of the minus 200-mesh material contained in the leaching plant feed. Material so removed is being impounded for future treatment. Plans are being made for a plant to treat these fines, and its construction will be completed, according to present indications, in the near future.

A total of 73,415 tons of low-grade material had been hauled to the heap-leaching dump at the end of 1928. Preparations for leaching this material were in progress. During the year good progress was made on preparation for mining the sulphide ore tributary to the eighth level of the Live Oak section, and undercutting operations in this area were started in November. Development of leaching ore in the eastern end of the Inspiration section eighth level was begun during the year. Production from this area is expected to start by the middle of 1929.

The concentrator operated 354 days during 1928, with an average of 5.3 sections in operation. Recoveries obtained in 1928 exceeded the average of any preceding year of operation. During the year a total of 3,040,171 dry tons of ore was charged into the tanks at the leaching plant. This tonnage represents 352 leaching charges, or an average of 8,636.8 dry tons per tank. Metallurgical results from the leaching of 352 charges are shown in the following tabulation:

	Per Cent
Feed:	
Total copper	1.019
Tailing:	
Total copper	0.200
Extraction:	
Total copper	80.373

Early in 1929 all tanks were charged with deslimed ore as a regular procedure, resulting in a material increase in the recovery of copper.

The cost of copper produced during the year, including depreciation but excluding depletion and federal taxes, amounted to 10.6624c. per pound. No major items of construction were performed during the year. Inspiration's floating debt, through operation of its market fund, provided in the agreement covering the issue of $6,000,000 6½ per cent gold notes, dated March 1, 1926, due March 1, 1931, was reduced by the sum of $500,000 on March 1, 1928.

EXPLORATION COMPANY, LTD., British holding company interested in several Mexican mining properties, reports £61,260 13s. 7d. transferred from profit-and-loss account to surplus as the profit from operations in 1928. This compares with £104,038 13s. for 1927, which was unusually large because of the sale of the company's Suchi Timber shares in that year. The company substantially increased its holdings in El Oro Mining Company in 1928. A continuation of the company's dividend rate at 1s. 3d. per share, less income tax, was decided upon at the ordinary annual general meeting of the company held in London, March 19.

Mohawk's Net Profit Up 50 per Cent in 1928

NET PROFIT of the Mohawk Mining Company was $1,284,736 in 1928, compared with $864,931 in 1927, an increase of approximately 50 per cent. The higher price for copper accounted for the improvement in earnings, as the company's 1928 production of 21,243,265 lb. of copper was somewhat less than the 1927 output of 22,128,840 lb.

Profit-and-Loss Account for 1928

Income		
Copper sold		$3,227,433
Costs		
Copper on hand, Jan. 1, 1928	329,200	
Operating expenses	1,239,495	
Smelting, freight and New York expenses	322,625	
Taxes	57,187	
Total		$1,948,508
Less copper on hand Dec. 31, 1928, at cost		$294,353
Net cost of copper delivered		1,654,154
Profit on copper delivered		$1,573,278
Miscellaneous Income		
Profit before depreciation, depletion and income tax allowance		$1,727,760
Deduct:		
Depletion—net	$131,391	
Depreciation	227,964	
Reserve for federal income tax	83,667	
		$443,022
Net profit		$1,284,736

Mohawk mine's life has been estimated at from six to seven years at the current rate of production. Operations at No. 4 shaft were discontinued July 19, 1928. The company has been experimenting with flotation to reduce its tailing losses and expects to install considerable flotation equipment at its stamp mill at Gay during 1929.

NORTH BUTTE MINING COMPANY, at its annual meeting, voted to sell an additional 125,000 shares of capital stock at not less than $8 per share. When this sale is consummated it will give the company over two million dollars cash for development purposes.

AMERICAN POTASH & CHEMICAL CORPORATION reports net profit of $1,556,541 for the year ended Dec. 31, 1928. During 1928 the company produced 138,291 tons of potash and borax salts. In 1927 its production was 103,753 tons and in 1926, 47,776 tons. The company expects to increase its output further in 1929. During 1928 the carload price of borax declined from $75 to $50 per ton.

London Financial News

By W. A. Doman
Special London Correspondent

London, April 16, 1929—Metals, particularly copper, have fluctuated considerably during the past week, and on balance are again lower. As the combine known as Copper Exporters, Inc., has been criticized in this connection, it issued an official statement last Friday in which it set out its view of the position. It states that the existing condition in the copper industry is the result of the unprecedented demand of the past year, to meet which all facilities of the industry have exerted every possible effort, there being an increase of 22 per cent in the first three months of this year over the first quarter of 1928. Notwithstanding that production was increased as soon as could be foreseen, the time required for the product to reach the market resulted in a reduction of refined stocks of 40,000 tons. Buying waves became increasingly difficult to satisfy, and commitments for farther forward deliveries were demanded, reaching a climax during March, when sales for domestic delivery aggregated 110,700 tons and for export, 51,400 tons, a total of 162,100 tons, an increase of 40 per cent over the first quarter of 1928, total forward contracts reaching 460,000 tons. A shortage was, therefore, created. The decline in price began in the European speculative market, and was augmented by the offering for resale of copper from Europe in the United States, shaking confidence and stopping demand. Copper Exporters, Inc., does not hold itself responsible for the fluctuations.

Tin has also fluctuated, and it is reported that the group which has been holding up the metal has sold 1,000 tons. The members of the group profess not to be worried at the fall, but it is suggested that certain individuals are "getting the wind up." To assist the Nigerian mining industry, an Electricity Supply Corporation is being formed, with a capital of £450,000 in preferred ordinary shares of £1 each and 200,000 ordinary shares, also of £1. The sponsors are the Anglo-Oriental and General Investment Trust, Ltd. The new corporation has a charter for 45 years. Its initial installation comprises three units, each having 2,000-hp. capacity.

Hugh F. Marriott has returned from his trip to the property of the Panama Corporation, of which undertaking he is an ordinary director—not the consulting engineer. He expresses himself as pleased in every respect, and says that the reports that have been issued concerning the prospects have understated rather than overstated the position. As regards both alluvial and lode mining, the future is promising. Very high assays returns have been secured, and in order that the public here should not be misled he has instructed 50 tons of ore to be dispatched to this side. The consignment is now on its way, and will be consigned to Messrs. Holloway & Company for assay. This is a good bulk sample and has not been picked. At Mr. Marriott's suggestion, a further 2,600 square miles of concession have been secured from the Panama government.

From Valparaiso the announcement has been made that Compañia Salitrera Agua Santa has acquired the Antonia nitrate field for £360,000 cash.

Jackling Optimistic on Copper

Colonel D. C. Jackling, president of Utah Copper Company and of Nevada Consolidated Copper Company, views the immediate outlook for copper with considerable optimism, according to a statement released just before his departure from New York for an extended vacation trip abroad and published in the *Wall Street Journal* of April 29, 1929. Colonel Jackling stated that never in his experience has the copper industry been on a sounder basis than it is today. The increasing demand for copper products is the best proof that industry will maintain itself in a highly prosperous condition. It is his opinion that the copper-consuming public will continue to absorb the current copper production, and talk of curtailing the present tonnage seems to him totally unnecessary. As to the stabilization of any price level for copper, he regards the present price at around 18c. per pound as most likely to remain for some time. The outlook for copper companies, generally, is exceedingly prosperous, and he believes the industry will continue to reflect this improved tone.

Ohio Copper Company reports net profit for 1928 of $63,162. The company produced 3,973,282 lb. of copper from its leaching-in-place operations in Bingham Canyon, Utah, at an average cost of 11.428c. per pound. Exploration and development work in the limestone beds has been carried on during the year under the guidance of Ira B. Joralemon, consulting engineer, and the company considers the outlook for success most encouraging.

Mayflower-Old Colony Copper Company reports the disbursement of $55,833 during 1928 as mining expense in the development and exploration of the company's ground in the Michigan copper country. A total of 1,240 ft. of drifting and crosscutting was carried on during the year. During the progress of this work several promising-appearing amygdaloid beds were cut, two of which carried some copper.

Callahan Zinc-Lead Company, operating in the Coeur d'Alene district, Idaho, reports a net loss on its 1928 operations, before depletion or depreciation, of $57,553, compared with a profit of $70,179 in 1927. The company suspended mining operations in October, 1928; since that date all work has been confined to development and new explorations. During 1928 a settlement of the government's claim for back taxes and interest of $175,000 was settled for $115,195.

Benguet Consol. Reports Greater Earnings in 1928

Report of the Benguet Consolidated Mining Company, Philippine Island gold and silver producer, shows net profit of 1,238,074 pesos in 1928, compared with 584,344 pesos in 1927. The company reports good progress on its three major projects: the Colbath drain tunnel, the Balatoc mine and mill, and the North Luzon Power Company. Profit and loss account for 1928 follows:

	Pesos
Receipts	
Bullion	2,717,928
Exchange	12,306
Interest	30,779
Rentals	5,676
Store operations	28,712
	2,795,404
Expenditures	
Labor	505,726
Supplies	601,045
Taxes	96,699
School and hospital	13,588
Insurance	4,968
Marketing bullion	20,165
Mine miscellaneous	122,226
Manila office	73,545
Total	1,437,966
Gross profit	1,357,438
Less depreciation	86,616
Less reserve for ore depletion	1,002
	87,618
Total	1,269,819
Less bonus to general manager	31,745
Net profit	1,238,074

Ore reserves at the end of 1928 were estimated at 290,929 tons, with a gross value of 7,372,664 pesos.

East Butte Copper Company, operating the Pittsmont mine, at Butte, Mont., a lime quarry at Lime Spur, Mont., and having an interest in several other properties in Colorado and Nevada, statistically summarizes its operations for the year ended Dec. 31, 1928, as follows:

Tons of copper ore mined—dry—Pittsmont mine	110,997
Average assay, per cent copper	4.41
Average assay, ounces silver	4.04
Pounds copper paid for	8,537,068
Ounces silver paid for	389,860
Ounces gold paid for	1
Tons of copper precipitates produced—dry—Pittsmont mine	41
Average assay, per cent copper	62.53
Pounds copper paid for	47,565
Gross value ores shipped—Pittsmont	$739,521
Value of smelter clean-up—Pittsmont	9,010
Gross value lime rock sold	40,876
Profit on copper sales	16,177
Other income	46,235
Gross income from all sources	851,820
Operating costs—Pittsmont	685,004
Operating costs—lime quarry	44,536
Development costs—Silver Plume, Colo.	2,175
Operating costs—miscellaneous	8,470
Maintenance of properties—East Butte	4,298
Total cost of operations and maintenance	744,485
Gross profit	107,335
Less depreciation on equipment—East Butte	5,435
Less foreign exploration	555
Less miscellaneous charges	596
Net profit on all operations	100,747
Profit on Pittsmont operations transferred	63,526
Profit on East Butte operations	37,220
Price per pound copper received, cents	14,505
Cost per pound copper delivered, cents	13.870
Profit per pound copper, cents	0.635
Average price received for silver per oz, cents	58.201

Development work since the first of the year has revealed some improvement in underground conditions at the Pittsmont mines.

The Market Report

Metal Markets Still Inactive

New York, May 1, 1929—The situation in the metal markets is entirely unchanged from last week, buyers in general taking little interest, and sellers quoting unchanged prices and being content to wait until demand manifests itself rather than force metal on an unwilling market by cutting prices.

Copper continues at 18c., delivered at usual Connecticut points, but the volume sold is only nominal and has declined for the last three weeks. The large producers are not selling anything at all, such business as there is going to the custom smelters. The latter are probably not selling their total intake, but there are no indications that this is worrying them. With the larger supplies expected to be available, copper buyers may resume their former practice of buying for delivery inside of sixty days, in which case business seems unlikely to pick up much before June. Foreign sales in April were exceedingly small, the export market being much quieter even than the domestic market. Quotations are unchanged at 18.30c., c.i.f.

Lead business has been slightly less than in the last few weeks. The general situation, however, appears to be quite firm. London quotations are fairly stable at around £24½, and production statistics recently released show a considerably lessened output in recent months, all of which tends to improve the statistical situation and is indicative of a considerable period of price stability. All sales in the East have been at the 7c. per pound level; in the Middle West the price is fairly steady around 6.80c.

Again this week, only a few hundred tons of zinc have been sold. Most of the producers continue to quote 6.80c., St. Louis, but their sales are confined to only an occasional carload. Others have sold for as low as 6.55c., but interest at that level is equally small, as consumers are covered for their near-by requirements.

Tin had another slight relapse last week; today's quotation is about 1c. below that of a week ago. Support from the London "Group" has been in evidence recently, though there has been little change in the rate of consuming demand. Some interests in the trade feel that the market will need a great deal more support than it has had if prices are to be prevented from falling further.

During the last week lower rates for China exchanges, with sales from that quarter, have had a further depressing

Daily Prices of Metals

April May	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
25	17.775	44.125	7.00	6.80@6.825	6.625
26	17.775	43.875	7.00	6.80@6.825	6.625
27	17.775	44.00	7.00	6.80	6.60
29	17.775	43.875	7.00	6.80	6.60
30	17.775	44.125	7.00	6 80	6.60
1	17.775	43.875	7.00	6.80	6.60
	17.775	43.979	7.00	6.804	6.608

Average prices for calendar week ending April 27, 1929, are: Copper, 17.775; Straits tin, 44.354; N. Y. lead, 7.000; St. Louis lead, 6.817; zinc, 6.621; and silver, 55.396.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

April May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
25	77¼	74¼	83¾	201¼	203	24 7/16	24	25 15/16	25 13/16
26	75¼	73¼	83	196¼	198½	24⅜	23 15/16	26½	26 7/16
29	75⅝	72⅝	83	198⅝	200⅞	24⅜	23⅞	26¾	26½
30	77¼	73	83	198	200½	24½	24	26¾	26¾
1	78¼	74½	83	196¾	199⅜	24 7/16	24 1/16	26⅝	26⅞

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

April	Sterling Exchange "Checks"	Silver		Gold London	April May	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
25	4.84¼	55½	25⅜	84s11d	29	4.84¼	54⅝	25 5/16	84s11 1/32d
26	4.84¼	55⅛	25½	84s11 1/32d	30	4.84 13/16	54½	25 7/16	84s10 31/32d
27	4.84 13/16	55⅛	25⅜	.....	1	4.84 13/16	54¾	25 5/16	84s11d

Average: Silver, 54.938c.; Sterling Exchange, 484.781c.

New York quotations are as reported by Handy & Hartman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Average Metal Prices for April, 1929

COPPER:	
New York Electrolytic	19.500
London Standard Spot	81.036
London Electrolytic Spot	89.405
LEAD:	
New York	7.187
St. Louis	7.025
London Spot	24.783
London Forward	24.408
SILVER:	
New York	55.668
London	25.738
Sterling Exchange	484.808
ZINC:	
St. Louis	6.658
London Spot	26.759
London Forward	26.613
TIN:	
Straits	45.858
London	206.887
QUICKSILVER	122.000
ANTIMONY	9.462
PLATINUM:	
Refined	70.000
Crude	60.000
ALUMINUM 99 Per Cent Plus	24.300

effect on silver, the New York market touching 54⅝c. on April 29th, the lowest price quoted since Sept. 2, 1927. The market is quiet and featureless, with an uncertain tendency.

Mexican Dollars (old Mexican pesos): April 25th, 41½c.; 26th and 27th, 41⅜c.; 29th, 41⅛c.; 30th and May 1st, 41¼c.

Closing cable quotations on the principal foreign exchanges on Tuesday, April 30, follow: Francs, 3.90⅞c.; lire, 5.23¾c.; and marks, 23.70¾c. Canadian dollars, 51/64 per cent discount.

Smelters Taking Less Blende

Joplin, Mo., April 27, 1929

Blende	Per Ton
High	$46.35
Premium blende, basis 60 per cent zinc	$44.00@ 45.00
Prime Western, basis 60 per cent zinc	43.00@ 44.00
Table concentrates, 60 per cent zinc	41.00@ 43.00
Flotation concentrates, 60 per cent zinc	38.00@ 41.00
Average settling price, all zinc ore	42.28
Galena	
High	$93.20
Basis 80 per cent lead	90.00
Average settling price, all lead ore	91.92

Shipments for the week: Blende, 9,437 tons; lead, 3,376 tons. Value all concentrates the week, $709,370.

Smelters having supplied their bins with stocks of zinc concentrates against advance orders for metal, and facing a slackened demand for their product, are now buying a lessened tonnage, resulting in a change from a decreasing to an increasing reserve stock in mine bins.

Reserve stocks of lead concentrates are the lowest in more than a year. Producers are generally accepting the lower price for current output.

Steel Production Slump Fails to Materialize

Pittsburgh, April 30, 1929

The recent course of the steel trade has been notable in two respects. Production since the first of the year has been 12 per cent above that of a year previous, which was a record high at that time, and there is now no seasonal recession. In every one of the last five years production had begun decreasing by this date, but now the condition of mill order books and the pressure for deliveries indicate that there will be no decrease in the near-by future. At the beginning of April the bar, sheet, and strip mills were behindhand in deliveries by an average of about 30 days, and they have not caught up to any appreciable extent, and during the month the shape mills have been falling further behindhand. There is a virtual absence of semi-fiinished steel in the market, and although nominal asking prices have been advanced $2 a ton on billets and slabs and $1 on sheet bars, it is possible that prompt deliveries, if offered, would bring a premium.

Of the increase in steel production from that of last year, fully two-thirds is accounted for by the much larger production of automobiles, and there have been such increases in fabricated structural steel, agricultural-implement, and line-pipe requirements that leeway remains slight for slight decreases in some other lines. Within a short time automobile production will necessarily decrease, and the conclusion of the heaviest shipments of rails, even though deferred, will hardly come later than the end of July. On the other hand, fabricated structural steel shipments are increasing, and seasonal gains will continue in pipe and sheets for building work and steel for road building, so that less of the usual tapering off to a dull July is in prospect this year.

Finished-steel prices are quite steady and are not an issue in the present market.

Pig Iron—Asking prices have been marked up 50c. per ton, but with a dull market the advance has had little test, and the market is quotable at ranges, $18.50@$19 for Bessemer and malleable and $18@$18.50 for basic and foundry, f.o.b. Valley furnaces.

Connellsville Coke—The market has been very dull, and spot furnace coke is easier, at $2.75@$2.85, spot foundry remaining at $4@$4.50 for standard grades.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c. London, 98 per cent, quoted at £95 per long ton, less 2 per cent for domestic consumption.

ANTIMONY—Per lb., duty paid: Chinese brands, for all positions, 9@9⅛c. Cookson's "C" grade, spot, 14¾c. Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c. Nominal.

BISMUTH—Per lb., in ton lots, $1.70. Smaller lots $1.85 and up. London 7s. 6d.

CADMIUM—Per lb., 85@95c. Active. London, 4s. 2d.@4s. 3d. for Canadian metal, early delivery.

CHROMIUM—Per lb., 97 per cent grade, $1.50.

COBALT—Per lb., f.o.b. Canadian works: Shot or rondelles, 96@98 per cent, $2.50. Black oxide, 70 per cent, $2.10. London, 10s. for metal in small lots. 8s. for black oxide; 8s. 10d. for gray.

[1]GERMANIUM OXIDE—Per gram in 300- to 500-gram lots, $3.50.

IRIDIUM—Per oz., $260@$265 for 98 @99 per cent sponge and powder. London, £57@£60.

[1]LITHIUM—Per oz., 98@99 per cent grade in 1- to 5-lb. lots, $5.

MAGNESIUM—Per lb., in ton lots, single orders for spot metal: 8-lb. ingots (3x3x15 or 16 in.), 85c.@$1.05, depending on quantity; 2½- or 3-lb. sticks (1⅜ in.). $0.90@$1.10, depending on quantity; 10-oz. sticks (1x12 in.). 85@90c. Discounts up to 20 per cent on larger orders or contracts. London 3s. 3d.@3s. 9d. for 99 per cent ingots or sticks.

[1]MOLYBDENUM—Per lb. in 1- to 3-lb. lots, 99 per cent, $18. (Usually sold as calcium molybdate or ferromolybdenum, which see).

NICKEL—Per lb., ingot 35c.; shot 36c.; electrolytic, 35c. (99.90 per cent), for single lots of spot metal. London, per long ton, £170@£175 according to quantity.

OSMIUM—Per oz., $58@$65; London, £12@£14.

PALLADIUM — Per oz., $38@$40. London, £7 5s.@£8 5s.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $70. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

London, per oz., £13 17½s., for refined; crude and scrap, nominal at £11 10s.@£12.

QUICKSILVER—Per 76-lb. flask, $122. Small lots command the usual premiums. San Francisco wires $123 for retail and small wholesale lots. London quiet, with offers of spot at £22 2½s.@£22 5s.

RADIUM—Per mg. radium content, $70.

RHODIUM—Per oz., $45@55. Nominal. London, £11@£12.

RUTHENIUM — Per oz., $45@$55. Nominal. London, £9@£10.

[1]SELENIUM — Per lb. in ton lots: Black, powdered, amorphous, 99.5 per cent pure, $2.25. London, 7s. 8d.@ 7s. 9d.

TANTALUM — Per gram: Bar and heavy sheet, chemically pure, 20c.; tantalum powder, 11c.

TELLURIUM—Per oz., 15@18c.

THALLIUM METAL—$12.50@$15 per pound.

TITANIUM—Per lb., 80@90 per cent grade, $5.

TUNGSTEN POWDER—Containing 97 to 98 per cent tungsten, per lb., $1.35@ $1.55, depending on quantity. Nominal.

VANADIUM—Per gram, 92@95 per cent grade, $1.25.

[1]ZIRCONIUM METAL—Per oz., 98 per cent grade, $1.56 in 5- to 10-lb. lots.

Metallic Ores

ANTIMONY ORE—Bolivian ore, 60 per cent metallic antimony, $1.35 per short ton unit, c.i.f. New York. Market quiet but firm.

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, Indian and Rhodesian ores, $22 for 47 per cent Cr_2O_3 ore to $23.50@$24.50 for 50@51 per cent ore. New Caledonian ore, high-grade, $25.

IRON ORE—Per long ton, lower Lake ports. Lake Superior ores:

Mesabi, non-bessemer, 51½ per cent iron, $4.50. Old Range, non-bessemer, $4.50.

Mesabi, bessemer, 51½ per cent iron, $4.65. Old Range, bessemer, 51½ per cent, $4.80.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 8c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

North African, low-phosphorus, 11½@11¾c.

Spanish and North African basic, 50@60 per cent, 10@11c. Nominal.

Swedish foundry or basic, 66@68 per cent, 9@10c.

Newfoundland foundry, 55 per cent, 8½@9c.

MANGANESE ORE—Per long-ton unit of Mn, c.i.f. North Atlantic ports. Exclusive of duty. Brazilian and Indian ores, minimum 47 per cent Mn, 30@32c. Caucasian (washed), 53@55 per cent, 36@38c.

Per ton in carload lots:

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2. Brazilian and Cuban, $70@$80. Caucasian, minimum 85 per cent, $70. Montana, 70 to 75 per cent, $70@$80. Domestic, 70 to 72 per cent, $40@$50.

TANTALUM ORE—Per unit of Ta_2O_5, basis 60 per cent ore, $13.

TITANIUM ORE—Ilmenite, per gross ton, 50 per cent TiO_2, f.o.b. Atlantic seaboard, $9.50@$11, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, per lb., guaranteed minimum 94 per cent concentrate, 10c. in carload lots.

TUNGSTEN ORE—Per short-ton unit of WO_3, N. Y.: Wolframite, $15.50@$16. Increased demand, coupled with political troubles in China, causing a decrease in production, has created an actual shortage of ore. Some authorities feel that there is no possibility of relief from this condition within the next six to nine months, believing that it will require at least that long for increased production from China and South America to become available. Western scheelite, $16 bid, but none offered.

VANADIUM ORE—Per lb. V_2O_5 contained, 28c.

ZIRCON ORE—Per net ton containing 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]AMBLYGONITE—Per ton, f.o.b. mines: 8@9 per cent lithium oxide, $50@$60.

ASBESTOS—Per ton: f.o.b. Quebec mines, tax and bags included, prices quoted by leading interest for delivery on 1929 contract:

Crude No. 1, $550@$750; crude No. 2, $450@$575; spinning fibers, $225@$275; magnesia and compressed sheet fibers, $175@$225; shingle stock, $55@$115, various grades; paper stock, $45@$50; cement stock, $25; short fibers, $10@$20; floats, $12@$15. Europe reports a general shortage of Canadian spinning fiber and No. 2 crude.

Per ton c.i.f. New York: Rhodesian crude No. 1, $450; No. 2, $350.

BARYTES—Per ton: f.o.b. mines, bags extra:

Georgia: Barytes ore, crude (per long ton), $6.50. Washed and water floated to 97 per cent through 300 mesh, $19. Tonnage requirements for April were about 70 per cent of normal.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $7.25 f.o.b. mines. Market good.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $7.50@$8.25 f.o.b. *Alabama* and *Arkansas* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $6.75@$8.25 f.o.b. *Arkansas* mines. Pulverized and dried, $12@$14 f.o.b. *Arkansas* mines; calcined, 78 to 84 per cent Al_2O_3, $18@$20 f.o.b. *Arkansas* mines.

Per metric ton, foreign c.i.f. Atlantic port: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.50@$6.50; Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$7; French, 56 to 59 per cent Al_2O_3, 2 to 5 per cent SiO_2, $6@$8.

BORAX—Per lb.: Carload lots, in bags, crystals, 2¾c.; granulated or powdered, 2½c.; f.o.b. consumers' shipping point.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHALK—Per ton: Crude in bulk, c.i.f. *New York*, $4.75@$5.

CHINA CLAY (KAOLIN)—Per ton: F.o.b. *Virginia* mines, crude lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $8@$15; ground, $7@$15.

Florida, pressed pottery, bulk, $13; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour in 100-lb. bags (bags extra), No. 1, $20; No. 2, $17. Market quiet.

Best grade, domestic, $16@$18, f.o.b. *Delaware* plants in carload lots. Market slow.

Imported English, f.o.b. American ports: Lump, $13@$21; powdered, $40@$45.

DIATOMITE—Per short ton, f.o.b. producing plant:

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $25; natural aggregate, ¼ in., $18@$20; air-floated powder, $45; 80 to 85 per cent silica, 98 per cent through 200 mesh, $20 in carload lots.

EMERY—F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 6½c.; domestic, 3½c.

FELDSPAR—F.o.b. mine or grinding plant:

North Carolina, per long ton, No. 1 pottery grade, crude, $6.50@$7.50; glass grades, $5@$6.

No. 1, pottery, 140 mesh, $16; 200 mesh, $18. No. 2, enamel, 20 mesh, $10.25; 90 mesh, $12; 140 mesh, $13.75; 200 mesh, $15.50. No. 3, 20 mesh, $9. Market good.

New Hampshire, per ton: Pottery grade, $8. Best quality lump, $9.

New York, per ton: f.o.b. cars, No. 1 crude, $9. Soda feldspar, 140 mesh, first grade, $18 per short ton; 200 mesh, first grade, $20 per short ton. Market dull.

Maine, per ton: Best pottery grade, ground, $19. Market fair.

FLUORSPAR—Per ton: F.o.b. *Kentucky* and *Illinois* mines:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $32.50 in car lots. Prices and conditions unchanged, but buying for second-half 1929 is expected to appear soon.

New Mexico: 85-5 gravel, $16.50; 85-5 lump, $17; 94-3 lump, $21; 96-3 100-mesh, $30. Market good.

Foreign spar, duty paid, $19.40, tidewater.

FULLER'S EARTH—Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 16 to 60 mesh, $17; 60 to 90 mesh, $14; 100 mesh up, $7. Market very good.

Powdered, import duty paid, $24@$25 per ton.

GARNET—Per ton; domestic, f.o.b. mines, $85.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE—Per ton, carload lots, f.o.b. mines *Colorado*.

Selected grade, $33; seconds (mine run), $25.50. Normal market.

GRAPHITE—Per lb., f.o.b. *New York:* Ceylon lump, 7¼@8¾c.; chip, 6½@7½c.; dust, 3@5½c.; Madagascar flake, 6½@7c. Market fair.

No. 1 flake, 10c. and up. No. 2 flake, 6c. and up. Foundry facings, 3c. and up. Graphite facings, 4c. and up. Amorphous and crystalline, fine ground, 8c. and up. Market highly competitive, and prices considered very reasonable. The tariff issue is again being agitated, which some trade factors feel is only in the interest of promoters.

Crude amorphous graphite, $15@$35 per ton, according to grade.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade, in carload lots, $20.

GYPSUM—Per ton, f.o.b. mill, depending upon location: Crushed, $1.70@$6; ground, $4@$9; agricultural, $4@$9; calcined, $4@$13.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

[1]LEPIDOLITE—Per ton: $20@$30 for ordinary grades. Nominal.

[1]Price given by Foote Mineral Co., Philadelphia.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 25c.@$3.

Agricultural, 40c. up to $5 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE — Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $43; Grade B, $40; dead burned, $29; crude, $11. *Washington:* Dead-burned magnesite, $22@$24 per net ton, Chewelah, Wash. Market inactive.

MICA—Per ton, f.o.b. plant:

New Hampshire: Mine run, $250; clean shop scrap, $25; roofing, $25. White dry ground, 20 mesh, $28; 40 mesh, $38; 60 mesh, white, $55; off-color, $34; 100 mesh, $70; 200 mesh, $80. Granite mica facings for cement block and stucco use, $8@$12, depending on size between ¼ in. and 60 mesh.

North Carolina: White, ground, 20 mesh, $35; 70 mesh, $100. Market conditions in this area have improved considerably in the last two months. Prices are appreciably firmer, though a difference of opinion exists as to whether this is the result of increased consumption or anticipation of an increase in tariff.

Madagascar, amber, per lb., f.o.b. *New York*, duty paid: No. A1, $2.50; No. 1, $2; No. 2, $1.65; No. 3, $1.15; No. 4, 60c.; No. 5, 45c.

[1]MONAZITE—Per ton: (Minimum 6 per cent ThO_2), $80.

OCHER — F.o.b. *Georgia* mines, per ton: $19@$20 in sacks; $21@$22 in barrels; washed and water floated, $18; second grade, 99 per cent through 225 mesh, $18.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10. Prices firm.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent, $4.

Tennessee, ground, 90 per cent through 200 mesh, 33 per cent P_2O_5, $11.20 per short ton. Brown lump for acid manufacture, per gross ton, $6 on 75 per cent basis; $5.25 on 72 per cent basis. Non-acidulated, fine ground, 65 per cent, $8 (per short ton).

POTASH—The ruling contract prices are as follows:

	Bags	Bulk
Muriate of potash 80 @ 85 per cent, basis 80 per cent	36.40	34.80
Sulphate of potash 90 @ 95 per cent, basis 90 per cent	47.30	45.70
Sulphate of potash-magnesia 48 @ 53 per cent, basis 48 per cent	27.25	25.65
Manure salt 30 per cent	21.75	18.75
Manure salt 20 per cent	15.40	12.40
Kainit 14 @ 16 per cent	12.50	9.50
Kainit, 12.4 per cent	12.00	9.00

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

PUMICE STONE—Per lb.: In barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur: C.i.f. United States ports: guaranteed 48 per cent sulphur: Spanish 13c.; Tharsis, furnace size, 2½ in. diameter, 14c. Cinder from ore to remain property of buyers.

[1]QUARTZ ROCK CRYSTALS—Per lb. in ton lots: Colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 20c. For optical purposes, four times above price; larger crystals still higher.

SILICA—Per ton: Water ground and floated, in bags, f.o.b. Illinois: 400 mesh, $31; 350 mesh, $26; 250 mesh, $18. Market fair. Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$3.50; blast sand, $1.35@$3.50.

[1]SPODUMENE — Per ton: $20@$30, depending upon lithium content.

SULPHUR—Per long ton for domestic market, $18 f.o.b. Texas mines; $22 for export, Atlantic ports. Prices in reality are on a c.i.f. basis, but the average price reduced to an f.a.s. figure is about as given. Open prices $1 to $3 higher than above.

TALC—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $9@$9.50; 97½ to 98½ per cent through 200 mesh, medium white, $8.50@$9; packed in 50-lb. paper bags; prices $1 per ton less in burlap sacks plus 15c. net for bags packed 12 to the ton.

New York: Double air-floated, short fiber, 200 mesh, $13.75; 325 mesh, $14.75.

Georgia: Powdered, gray, $7.50@$10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9.

New Jersey: Soapstone, ground, $10@$12.

TRIPOLI—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh, rose and cream colored, $16. Double ground through 110 mesh, rose and cream, $18. Air-floated through 200 mesh, rose and cream, $27.50; mill run, $16. Usual good spring business.

Metallic Compounds

ANTIMONY OXIDE—White, Chinese, 99 per cent Sb_2O_3, 14½c. per lb. Nominal.

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c.; delivered near by. Market firm. London, per long ton, £16@£16¼ quoted for Cornish white: Mexican high grade, £17, c.i.f. Liverpool.

CALCIUM MOLYBDATE OR MOLYTE — Per lb. of contained Mo, 95c., delivered.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 6c., for either large or small crystals.

SODIUM NITRATE—Per 100 lb.; crude natural, in bags ex vessel, Atlantic ports, $2.22½ for May and June deliveries.

SODIUM SULPHATE (Salt Cake)—Per ton, bags, f.o.b. works, $20; in barrels, $24@$33.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6⅝c.; French red seal, in bags, 9⅜c.

Alloys

[1]FERROCERIUM—Per lb., $8 in 15 to 75 lb. lots.

FERROCHROME—Per lb. of contained chromium, 60@70 per cent chromium, 4 to 6 per cent carbon, 11c. Freight allowed in carload lots east of Mississippi River and north of Baltimore.

FERROMANGANESE — Per gross ton furnace: Domestic and foreign, 78@82 per cent, $105. Spiegeleisen, 19@21 per cent, $33@$34 on carload business, f.o.b. furnace.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.20.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50; f.o.b. *Alabama* and *Tennessee*.

FERROSILICON—Per gross ton, f.o.b. works, freight allowed on carload lots east of Mississippi River and north of Baltimore: 50 per cent, $83.50; 75 per cent, $130; 15@17 per cent, $45, f.o.b. Suspension Bridge, N. Y. Quotations for spot shipments $5@$10 per ton higher on 50 and 75 per cent grades.

FERROCARBONTITANIUM — Per ton: $160, f.o.b. producer's plant.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.35, f.o.b. works. Market quiet but strong.

FERROVANADIUM—Per lb. of V contained, f.o.b. works, freight allowed, $3.15@$3.50, depending on grade and quantity. Market active.

NICKEL SILVER—Per lb. for 18 per cent nickel Grade A sheets, 34¼c.

YELLOW (MUNTZ) METAL—Dimension sheets, per lb., 25c.; rods per lb., 22¼.

Rolled Metals

COPPER—Sheets, hot-rolled, per lb., 27¾c.; wire, per lb., f.o.b. mill, 19⅞c.

LEAD SHEETS—Full rolled, 11c. per lb.; clipped, 11¼c.

MONEL METAL—Per lb., sheets, full finished, 42c.; rods, hot-rolled, 35c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

ZINC SHEETS—Per lb., 10¼c., f.o.b. works.

Refractories

CHROME BRICK—Per net ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M.: First quality, $43@$46, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35@$38.

MAGNESITE—Brick, per net ton, f.o.b. works: 9-in. straights, $65. Cement, $40, seaboard.

SILICA BRICK—Per M., *Pennsylvania* and *Ohio*, $43; *Alabama*, $51; *Illinois*, $52.

ZIRKITE—Per lb.; Powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1928	1929	1928	1929	1928	1929
January	57.135	57.019	26.313	26.257	487.098	484.577
February	57.016	56.210	26.205	25.904	487.008	484.787
March	57.245	56.346	26.329	26.000	487.558	484.776
April	57.395	55.668	26.409	25.738	487.785	484.808
May	60.298	.....	27.654	.....	487.685	.....
June	60.019	.....	27.459	.....	487.565	.....
July	59.215	.....	27.262	.....	485.923	.....
August	58.880	.....	27.096	.....	484.979	.....
September	57.536	.....	26.440	.....	484.654	.....
October	58.087	.....	26.727	.....	484.584	.....
November	57.953	.....	26.704	.....	484.492	.....
December	57.335	.....	26.349	.....	484.698	.....
Year	58.176	.....	26.746	.....	486.169	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London Spot			
	Electrolytic		Standard		Electrolytic	
	1928	1929	1928	1929	1928	1929
January	13.854	16.603	61.912	75.551	66.575	78.602
February	13.823	17.727	61.670	78.228	66.381	83.538
March	13.845	21.257	61.148	89.153	66.443	98.356
April	13.986	19.500	61.678	81.036	66.500	89.405
May	14.203	.....	62.554	.....	67.216	.....
June	14.527	.....	63.664	.....	68.738	.....
July	14.527	.....	62.881	.....	68.670	.....
August	14.526	.....	62.472	.....	68.750	.....
September	14.724	.....	63.522	.....	69.800	.....
October	15.202	.....	65.524	.....	71.935	.....
November	15.778	.....	68.080	.....	74.750	.....
December	15.844	.....	69.336	.....	75.000	.....
Year	14.570	.....	63.703	.....	69.230	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1928	1929	1928	1929	1928 Spot	1928 3 Mos.	1929 Spot	1929 3 Mos.
January	6.500	6.650	6.280	6.498	21.773	22.213	22.111	22.344
February	6.325	6.853	6.069	6.739	20.283	20.747	23.128	23.156
March	6.000	7.450	5.805	7.348	19.938	20.352	25.409	25.591
April	6.100	7.187	5.991	7.025	20.306	20.563	24.783	24.408
May	6.123	.....	6.012	.....	20.483	20.813	.....	.....
June	6.300	.....	6.152	.....	20.985	21.211	.....	.....
July	6.220	.....	6.038	.....	20.602	20.957	.....	.....
August	6.248	.....	6.056	.....	21.634	21.628	.....	.....
September	6.450	.....	6.286	.....	22.050	21.769	.....	.....
October	6.500	.....	6.318	.....	22.082	21.796	.....	.....
November	6.389	.....	6.222	.....	21.239	21.469	.....	.....
December	6.495	.....	6.343	.....	21.342	21.730	.....	.....
Year	6.305	.....	6.131	.....	21.060	21.271	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1928	1929	1928	1929
	Straits		Spot	
January	55.650	49.139	253.222	222.727
February	52.440	49.347	233.833	223.138
March	52.220	48.870	232.722	220.781
April	52.270	45.858	234.204	206.887
May	51.582	.....	230.886	.....
June	47.938	.....	217.280	.....
July	47.040	.....	212.449	.....
August	45.012	.....	212.847	.....
September	48.073	.....	215.663	.....
October	48.966	.....	222.005	.....
November	50.750	.....	232.875	.....
December	50.185	.....	227.586	.....
Year	50.427	.....	227.131	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1928	1929	1928 Spot	1928 3 Mos.	1929 Spot	1929 3 Mos.
January	5.643	6.350	26.125	26.051	26.196	26.233
February	5.551	6.350	25.518	25.506	26.247	26.347
March	5.624	6.463	25.082	24.960	27.050	27.294
April	5.759	6.658	25.493	25.316	26.759	26.613
May	6.026	.....	26.102	25.756	.....	.....
June	6.158	.....	25.664	25.429	.....	.....
July	6.201	.....	24.946	24.972	.....	.....
August	6.249	.....	24.540	24.713	.....	.....
September	6.250	.....	24.497	24.625	.....	.....
October	6.250	.....	24.030	24.296	.....	.....
November	6.263	.....	24.801	24.827	.....	.....
December	6.349	.....	26.609	26.615	.....	.....
Year	6.027	.....	25.284	25.256	.....	.....

St. Louis quotations, cents per pound. London pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)			
					Refined		Crude	
	New York		New York		New York			
	1928	1929	1928	1929	1928	1929	1928	1929
Jan.	10.863	9.558	123.620	119.481	79.280	70.000	69.280	60.000
Feb.	10.842	9.548	121.370	119.818	84.783	70.000	74.783	60.000
March	10.083	9.531	122.557	121.904	80.000	70.000	70.000	60.000
April	9.865	9.462	123.740	122.000	80.000	70.000	70.000	60.000
May	11.019	.....	123.173	.....	78.000	.....	68.000	.....
June	9.750	.....	122.423	.....	78.000	.....	68.000	.....
July	9.540	.....	121.260	.....	78.000	.....	68.000	.....
Aug.	10.181	.....	124.500	.....	78.000	.....	68.000	.....
Sept.	10.813	.....	128.000	.....	78.000	.....	68.000	.....
Oct.	10.841	.....	125.923	.....	78.000	.....	68.000	.....
Nov.	10.109	.....	123.000	.....	76.417	.....	66.418	.....
Dec.	9.748	.....	122.500	.....	74.480	.....	64.480	.....
Year	10.305	.....	123.506	.....	78.580	.....	68.580	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce.

Pig Iron[1] and Aluminum

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1928	1929	1928	1929	1928	1929	1928	1929
Jan.	17.50	18.00	17.00	17.50	17.25	17.50	24.300	24.300
Feb.	17.50	18.00	17.00	17.50	17.25	17.50	24.300	24.300
March	17.50	18.19	17.00	17.62	17.25	17.69	24.300	24.300
April	17.50	18.50	17.00	18.00	17.25	18.00	24.300	24.3 0
May	17.37	.....	16.38	.....	17.24	.....	24.300	.....
June	17.00	.....	15.56	.....	16.79	.....	24.300	.....
July	17.00	.....	15.75	.....	16.69	.....	24.300	.....
Aug.	17.00	.....	15.75	.....	16.50	.....	24.300	.....
Sept.	17.00	.....	15.75	.....	16.50	.....	24.300	.....
Oct.	17.24	.....	16.66	.....	16.74	.....	24.300	.....
Nov.	17.82	.....	17.32	.....	17.32	.....	24.300	.....
Dec.	18.00	.....	17.50	.....	17.50	.....	24.300	.....
Year	17.37	.....	16.56	.....	17.02	.....	24.300	.....

Iron in dollars per long ton. Aluminum in cents per pound, 99 per cent grade.

[1]F.o.b. Mahoning and Shenango valley furnaces; freight to Pittsburgh, $1.76.

Monthly Crude Copper Output in Short Tons

	1928				1929		
	Oct.	Nov.	Dec.	Total	Jan.	Feb.	Mar.
Domestic							
Alaska shipments	3,036	1,313	1,807	22,724	2,145	913	1,974
Calumet & Arizona	2,201	3,006	2,890	26,184	2,150	2,551	3,114
Magma	1,877	1,635	1,436	18,251	1,730	1,450	1,680
Miami	2,133	2,119	2,148	24,129	2,262	2,157	2,620
New Cornelia	3,190	3,340	4,143	38,998	3,104	3,002	2,774
Nevada Con	.....	.....	†40,613	134,231	.....	.....	.....
Old Dominion*	840	943	804	11,069	921	734	1,015
Phelps Dodge††	10,054	9,080	10,361	102,137	9,850	9,537	10,524
United Verde Extens.	2,065	2,133	2,344	22,073	2,338	2,024	2,504
Utah Copper	.....	.....	†42,956	136,920	.....	.....	.....
Tennessee Copper	621	639	558	6,792	597	616	635
Foreign							
Andes Copper	6,180	7,835	6,890	52,029	7,485	7,000	.....
Braden	9,265	10,438	4,740	109,137	6,510	.....	.....
Boleo, Mexico	.....	.....	†3,422	12,782	.....	.....	†2,910
Bwana M'Kubwa	530	533	649	6,696	812	605	686
Chile	14,368	14,080	15,380	132,932	15,645	15,085	.....
Furukawa, Japan	1,547	1,396	1,468	17,865	1,420	.....	.....
Granby Cons., Canada	2,447	2,359	2,465	28,767	2,677	2,324	2,452
Howe Sound	.....	.....	†5,490	21,099	.....	.....	†5,157
Mount Lyell, Aust'lia	.....	.....	†1,204	6,582	.....	.....	.....
Sumitomo, Japan	1,466	1,562	1,660	17,898	1,502	1,335	.....
Union Miniere, Africa	10,120	10,174	9,440	123,880	9,753	9,477	11,820

†Three months. *Includes Arizona Commercial.
††Moctezuma is included.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1927		1928		1929	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	76,198	2,458	68,469	2,209	86,325	2,785
February	69,202	2,472	67,423	2,352	84,735	3,026
March	69,314	2,236	70,327	2,269	93,303	3,010
April	71,122	2,371	69,721	2,324	.....	.....
May	71,613	2,310	73,729	2,378	.....	.....
June	69,539	2,318	73,224	2,441	.....	.....
July	65,545	2,114	73,426	2,369	.....	.....
August	67,248	2,169	76,952	2,482	.....	.....
September	65,936	2,198	78,341	2,611	.....	.....
October	68,545	2,225	86,480	2,790	.....	.....
November	68,080	2,269	85,382	2,846	.....	.....
December	67,377	2,173	85,673	2,764	.....	.....
Total	829,878	.....	909,147	.....	264,363	.....
Monthly average	69,165	.....	75,762	.....	88,121	.....
Average of daily rate	.....	2,274	.....	2,484	.....	2,937

Mining Stocks—Week Ending April 27, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	143¾	138½	142½	Mr.29,My.20 Q	1.75
Andes Copper	New York	53¼	51¼	53½	Mr.29, My.6 Q	0.75
Arizona Com	Boston	4	3½	3½	Ja. 16, Ja. 31 S.A.	0.25
Calumet & Ariz	New York	138¾	125	135½	My.31, Je.17 Q	2.50
Calumet & Hecla	Boston	46¾	46	46½	My.31, Je.29 Q	1.00
Cerro de Pasco	New York	102	98¼	101½	Ap.11, My. 1 Q	1.50
Chile Copper	New York	104	101	104	Je. 1, Je.28 Q	0.87½
Con. Coppermines	N. Y. Curb	13¾	12¾	12¾		
Copper Range	Boston	26	25	25¾	Mr.15, Ap.15 Q	0.50
East Butte	Boston	4½	4	4	Dec., 1919	0.50
Granby Con	New York	85½	83	84	Ap.12, My.1 Q	1.75
Greene Cananea	New York	165¼	158½	163½	Mr. 7, Ap. 1 Q	2.00
Howe Sound	New York	73¼	70½	72¾	Mr. 30, Ap. 15 Q	1.00
Hudson Bay	N. Y. Curb	19¼	18¼	18⅝		
Inspiration	New York	50	48¼	48¾	Mr.14, Ap. 1 Q	1.00
Isle Royale	Boston	26	24	24½	My. 31, Je.29	0.50
Kennecott	New York	90¾	84	90¾	No. 30, Ja. 2 Q	2.00
Magma Copper	New York	72	69	71½	Mr.30, Ap.16 Q	1.25
Mason Valley	N. Y. Curb	1 1/16	1⅛	1⅛		
Miami Copper	New York	45⅝	43¾	45⅛	My1, My15 Q	1.00
Mohawk	Boston	57½	56	56	Ap. 30, Je. 1 Q	1.50
Mother Lode	New York	4¼	4	4	De.14, De.31 SA	0.20
Nevada Con	New York	49¼	46¾	47½	Mr.15, Mr.30 Q	0.75
New Cornelia	N. Y. Curb	48¼	42¾	47⅜	Fe. 1, Fe. 18 Q	0.50
Noranda	N. Y. Curb	53	50	50⅞		
Ohio Copper	N. Y. Curb	2⅛	2⅛	2⅛	Sept., 1926	0.03
Old Dominion	Boston	14½	13¼	13½	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	302	298	302		
Phelps Dodge, new	N. Y. Curb	77¼	71⅛	77		
Quincy	Boston	42¼	39½	40	March, 1920	1.00
Roan Antelope	N. Y. Curb	45	43⅜	44½		
St. Mary's M. L	Boston	36½	35½	36	Fe.25, Mr.12	2.00
Seneca Copper	New York	7	6½	6⅝		
Shattuck Denn	N. Y. Curb	20⅜	19½	19⅝		
Sherritt-Gordon	Toronto	8.60	8.15	8.35		
Tenn. C. & C	New York	19⅛	18	18⅛	Fe.28, Mr.15 Q	0.25
United Verde Ex	N. Y. Curb	18¼	17⅛	18	Ap. 4, My. 1 Q	1.00
Utah Copper	New York	300	298	300	Mr. 15, Mr. 30 Q	3.00
Waite-Ack.-Mont	Toronto	3.50	2.00	3.00		
Walker Mining	Salt Lake	3.75	3.42½	3.75		
Wenden Copper	N. Y. Curb	1⅛	1⅛	1⅛		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	3	2⅞	3		
Amer. Z. L. & S	New York	36⅛	31½	33¾	May, 1917	1.00
A. Z. L. & S., pfd	New York	99	97½	97½	Nov., 1920	1.50
Bingham Mines	Boston	55	54¼	54¼	Mr.15, Ap.5	0.50
Bunker Hill & S	N. Y. Curb			145	Mr.28, Ap.5 X	0.75
Butte Cop. & Zn	New York	8	7⅛	7⅛		
Butte Cop. Con	Boston Curb	*57	*55	*56		
Butte & Sup	New York	8⅛	8⅛	8⅛	Mr. 15, Mr. 30 Q	0.50
Callahan Zn-Ld	New York	2⅜	2⅛	2⅜	Dec., 1920	0.50
Chief Consol	Salt Lake	3.65	3.40	3.65	Fe. 1, 1928 K	0.10
Consol. Ld. & Zn. "A"	St. Louis	15½	13	15	Ap.5, Ap.10	0.25
Constitution	Spokane	*33	*25	*32		
Dayrock	Spokane	2.55	2.47	2.53	Mr.23, Mr.30	0.03
Dickens Consol	Spokane	*4¼	*3	*3½		
Eagle-Picher	Cincinnati	19	18	18	Mr.31, Ap.15 Q	0.20
Eagle-Pich., pfd	Cincinnati			102	Jan. 15 Q	1.50
Erupcion	Boston Curb			*24	Ja. 1, 1928 Q	0.07½
Eureka Bullion	Salt Lake	1.00	*95	*96		
Eureka Lilly	Salt Lake			1.42½		
Eureka Standard	Salt Lake			5.00		
Evans-Wallower	N. Y. Curb	16⅛	15	16		
Evans-Wal., pfd	N. Y. Curb	84½	84½	84½	Mr.20, Ap.1 Q	1.75
Federal M. & S	New York			245	Je., 1927	10.00
Fed. M. & S., pfd	New York			98¾	Fe. 21, Mr. 15 Q	1.75
Gladstone	Spokane	*12	*10	*10		
Golconda	Spokane	1.50	1.40	1.43	Mr.20, Ap.1 Q	0.02
Grandview	Spokane	*51	*44	*44		
Hecla Mining	N. Y. Curb	18½	17⅞	18½	My.15, Je.15 Q	0.25
Highland-Surprise	Spokane	*16½	*14	*16½		
Jack Waite	Spokane	*12½	*11	*11		
Kootenay Florence	Spokane	*15¼	*14½	*15¼		
Lucky Jim	Spokane	*16	*14½	*15½		
Lucky Tiger-C	Kansas City	†5.60	†5.40		De.4, De.20 MX	0.12
Mexican Premier	Spokane	1.62½	1.60	1.60		
National Lead	New York	149⅛	144	145	Mr. 15, Mr. 31 Q	1.25
Natl. Lead, pfd. A	New York	141½	140	140	Mr. 1, Mr. 15 Q	1.75
Natl. Lead, pfd. B	New York	118	118	118	Ap. 19, My 1 Q	1.50
N. J. Zinc	N. Y. Curb			330	Ap.20, My.10 Q	2.00
N. J. Zinc, new	N. Y. Curb	84½	83¾	84¾		
New Quincy	Salt Lake	2.55	2.27½	2.37	My.15, My.27 Q	0.10
Noble Five	Spokane	*65	*60	*65		
North Lily	Salt Lake	8.85	8.00	8.85	Jan. 20 Q	0.25
Park Bingham	Salt Lake	*9¼	*6½	*7½		
Park Utah	New York	10½	10	10	Mr. 19, Ap. 10 Q	0.20
Pend Oreille	Spokane	7.00	6.00	6.50		
Rico Argentine	Salt Lake	42	42	42	No. 30, De. 15 Q	0.03
Ruth-Hope	Spokane	*42	*40	*40		
St. Joseph Lead	New York	69½	64¾	68¼	Ju. 8, Ju.20 QX	0.75
Sherman Lead	Spokane	*37½	*36¾	*37¼		
Silver King Coa	Salt Lake	14.50	14.25	14.25	Mr. 20, Ap. 1 Q.	0.25
Silversmith	Spokane	*15	*14½	*15	Oct., 1926 Q	0.02
Sunshine Mining	Spokane	1.80	1.70	1.80	De. 20, BM	0.02
Tamarack-Custer	Spokane	*74¼	*68	*68½	Sept., 1924	0.25
Tintic Standard	Salt Lake	14.50	14.00	14.00	De. 23, Ja. 23 X	0.20
Tonopah Belmont	N. Y. Curb	*81	*81	*81	Oct., 1925	0.05
Treadwell-Yukon	Toronto	13.50	13.00	13.00		
United Zinc Smg	N. Y. Curb	1⅛	1	1		
Utah Apex	Boston	5	4⅛	4⅛	May 15, June 1	0.25
Utah Met. & Tun	Boston	1 1/16	1 1/16	1 1/16	Dec., 1917	0.30
Whitewater	Spokane	1.05	1.00	1.05		
Yellow Pine	Los Angeles	*18	*15	*16	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	7⅛	6⅛	6⅛		
Barry-Hollinger	Toronto	*34	*30	*34		
Central Manitoba	Toronto	*52	*48	*48		
Coniaurum	Toronto			*45		
Cresson Consol	N. Y. Curb	*81	*76	*76	Mr.30, Ap.10 Q	0.02
Dome Mines	New York	10¼	9¼	10	Mr.30, Ap..20 Q	0.25
Golden Cycle	Col. Springs	†1.64	†1.60		Fe.15, Mr.1	0.04
Gold Hill	Toronto	*4½	*3	*4		
Hollinger	Toronto	7.40	7.15	7.25	My.3, My.20 M	0.05
Homestake	New York	76	69¾	76	Ap.20, Ap.25 M	0.50
Kirkland Lake	Toronto	1.14	1.00	1.03		
Lake Shore	Toronto	27.00	26.50	27.00	Mr.1, Mr.15 Q	0.20
McIntyre-Porc	New York	19⅜	19⅛	19⅛	My.1, Je.1 Q	0.25
Portland	Colo.Springs	†*9	†*8		April, 1927	0.02
Rand Mines	New York	35	35	35	Fe. 21,'28 Am.Sh.	1.52
Siscoe	Toronto	*81	*65	*73		
Sylvanite	Toronto	1.80	1.65	1.70		
Teck-Hughes	Toronto	9.50	9.00	9.25	Ap. 7,My 1, O	0.15
Tom Reed	Los Angeles	*30	*30	*30	Dec., 1926	0.02
Unity Gold	N. Y. Curb	2⅛	1⅛	2⅛		
Vipond Consol	Toronto	1.14	1.07	1.09	April, 1927	0.03
Wright-Hargreaves	Toronto	2.10	1.70	1.80	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb			35¼		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	19¼	17¼	19		
Castle-Trethewey	Toronto	*35	*34	*34		
Consol. Cortez	N. Y. Curb			*18		
Dolores Esperanza	N. Y. Curb	1¼	1	1	July, 1923	0.05
Keeley	Toronto	*60	*44	*60	Mr.15, 1928	0.04
Mining Corp	Toronto	4.65	4.40	4.50	De.14,De.31 SA	0.15
Montana-Idaho	Spokane	*12½	*11	*11		
N. Y. & Hond. Ros	N. Y. Curb			18	Ap.17,Ap.27 QX	0.05
Nipissing	N. Y. Curb	3	2⅛	2⅛	Mr.30,Ap.20 Q	0.07½
Premier Gold	N. Y. Curb	2	1⅛	2	Mr.14, Ap.4	0.06
Tonopah Exten	N. Y. Curb			*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	3⅛	3⅛	3⅛	Ap. 7, Ap. 20	0.07½
United Eastern	N. Y. Curb	*81	*81	*81		
Yukon Gold	N. Y. Curb	*77	*75	*75	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	118⅛	110	111⅛	Jl.19, Au.15 Q	1.00
Beth. Steel, pfd, 7%	New York	119½	118	118⅛	Je.1, Jl.1 Q	1.75
Cleveland-Cliffs	Cleveland	220	185	210	Ap.15, Ap.25 Q	1.00
Colo. Fuel & Iron	New York	72⅛	67	67⅛		
Colorado F. & I., pfd	New York			133	Fe.11, Fe.25 Q	2.00
Great Northern Iron	New York	30⅛	29	29⅛	Dec.15, K	2.00
Inland Steel	New York	94½	92½	92½	Fe. 15, Mr. 1, Q	0.87½
Republic I. & S	New York	102¾	96	98½	My. 11, Je. 1, Q	1.00
Republic I. & S., pfd	New York	112	112	112	Je.12, Jl. 1, Q	1.75
Sloss-Sheffield S. & I	New York	112	112	112	Mr. 11, Mr.20, Q	1.50
Sloss-Sheff. S. & I., pfd.	New York			108	Mr.20, Ap.1, Q	1.75
U. S. Steel	New York	188⅛	184	186¼	Fe. 28, Mr. 30, Q	1.75
U. S. Steel, pfd	New York	143⅜	143	143⅜	Fe 2, Fe. 27, Q	1.75
Virginia I. C. & C	New York			23	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York	47⅛	47⅛	47⅛	Jl.16, 1928	SA2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	215	180½	205		
Alum.Co.of Amer., pf.	N. Y. Curb	107	106	106½	Mr.15, Ap.1, Q	1.50
American Metal	New York	59½	56½	58	My.9, Je. 1 Q	0.75
Amer. Metal, pfd., 6%	New York	119	119	119	My.21, Je.1, Q	1.50
Amer. Sm. & Ref	New York	106⅜	101⅛	105	Ap .12,My 1,Q	1.00
Amer. & Sm. Ref., pfd.	New York	136½	135½	136½	My. 3, Ju. 1 Q	1.75
Ang. Ch. Nitrate	N. Y. Curb	38½	37¾	38		
Asbestos Corp	Montreal	14	13	13	Jan. 1926	1.50
Asbestos Corp., pfd	Montreal	40	40	40	De. 31, Ja. 15 Q	1.75
Consol. M. & S	Montreal	435	425	425	De.31,Ja.15,SA	X6.25
De Beers Consol	New York			25	Ja. 19, Ja.26,	0.48
Federated Metals	N. Y. Curb	34	33	33¾	Mr.27, Ap.5 Q	0.75
Freeport Texas	New York	45½	44	45	Ap. 5, My. 1 Q	1.00
Int. Nickel Can	New York	51⅜	47⅜	48⅜	Mr.16, Mr.30 Q	0.20
Int. Nickel, pfd	New York			121	Ap.2,My.1No.1Q	1.75
Newmont	N. Y. Curb	213¾	200	210¾	Mr.30, Ap.15 Q	1.00
Patiño M. & E	New York	39¾	38½	38½	Ap. 20, Ap. 30	4a
So. America G. & P	N. Y. Curb	2¼	2⅛	2⅛		
Texas Gulf Sulphur	New York	83¼	81	82½	Mr.4, Mr.15 Q	1.00
U. S. Sm. R. & M	New York	61	58¾	61	Ap. 4, Ap. 15 Q	0.87½
U. S. Sm. R. & M., pfd.	New York	53	52½	52½	Ap. 4, Ap. 15 Q	0.87½
Vanadium Corp	New York	99	93½	94	Fe.1, Fe.15 Q	0.75

Toronto Standard Stock Exchange, Toronto, courtesy Arthur E. Moysey & Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Spokane Stock Exchange, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumprion. X, Extra. The first data given is that of the closing of the books; the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED APRIL 16, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	20/—	20/—	20/—		
Alaska Treadwell (25)	60/—	60/—	60/—	Nov., 1926	4p.c.(d)
Aramayo Mines (25 frs.)	66/9	65/7½	66/3	Feb. 1929	5p.c.(c)
Burma Corp (10 rupees)	17/6	16/9	17/3	Feb., 1929	7 annas*
Bwana M'Kubwa (5s)	20/1½	18/—	19/—		
Camp Bird (2s)	2/9	2/6	2/7½	April, 1928	16⅔ p.c.
El Oro (£1)	4/10½	4/6	4/9	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£)	9/—	9/—	9/—	Jan., 1929	3½ p.c.
International Nickel of Canada (no par value)	$51¼	$46	$48¼	Mar., 1929	20(c)
Mexican Corpn. (£1)	14/7½	12/6	13/6		
Mexican Mines of El Oro (£1)	6/3	4/6	5/—	Dec., 1926	3½ p.c.*
Mount Isa (£)	48/1½	46/10½	47/6		
N'Changa Copper Mining. (£1)	81/3	70/—	75/—		
Oroville Dredging (4s)	2/6	2/3	2/6	Nov., 1928	3⅛ p.c.
Rhodesian Congo Border (£1)	157/6	129/6	130/—		
St. John del Rey (£1)	15/9	15/1½	15/6	Dec., 1928	2½ p.c.
San Francisco Mines (10s)	37/—	35/1½	35/7½	Jan., 1929	25 p.c.
Santa Gertrudis (£1)	10/3	9/9	10/—	Jan., 1929	7½ p.c.
Selukwe (2s. 6d.)	7/3	6/6	6/9	April, 1917	6¼ p.c.
S. Amer. Copper (2s.)	3/—	2/6	2/9	Nov. 1917	75 p.c.
Tanganyika (£1)	66/10½	63/1½	63/9	July, 1928	5 p.c.
Union Miniere de Haut-Katanga (Brussels)	12,200	11,650	11,950	July, 1928	182.60 fr.(6)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.

(Price quoted in dollars with a fixed rate of $5 to the £1)